Current Science

Vol. XX] APRIL 1951 [No. 4

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MORE ABOUT THE IRIDESCENT FELDSPARS*

SIR C. V. RAMAN

BY reason of the brilliance and variety of the colours which it displays and of its availability in fairly large sizes, labradorite is easily the most spectacular amongst the iridescent feldspars. The explanation of the effects which it exhibits had also long remained rather mysterious. For these reasons, it was the first to be taken up for investigation. The ideas and methods of study which enabled the problem of its behaviour to be satisfactorily solved had evidently a wider field of application, and the next case which was accordingly taken up was that of the Ceylon moonstones, a fairly large collection of which was available for study. The optical effects which these display range in character from a soft blue or bluish-white shimmer to a brilliant white glitter, this being most prominent when the specimen is held in a particular orientation with respect to the direction of incidence of light on it and the direction of observation. The "Schiller" of the Ceylon moonstones—as this optical effect is called—was believed by mineralogists to be due to a lamellar structure of the material. Many of the earlier writers, *e.g.*, Boggild, were of the opinion that such structure lay beyond the power of the microscope to resolve. On the other hand, Dr. E. Spencer claimed that under certain favourable conditions of illumination, the structure responsible for the schiller could be observed under the microscope and even photographed. The assumption implicit in either explanation of the schiller effect is that it is in the nature of a geometric reflection of the light traversing the material by the layers of heterogeneity. The Bangalore investigations, however, showed that this assumption does not correspond with reality. The observations with the moonstones exhibiting a blue schiller proved that the optical effect actually shown by them is a diffusion of light over a very wide range of angles. The bluish-white or white schiller exhibited by other specimens is also essentially a diffusion of light, though the angular range over which its intensity is notable is considerably less than in the case of a blue schiller. From the distribution of intensity of the diffused radiation over the entire solid angle, it is possible to infer the nature of the structure giving rise to it. It is found that in all cases, the details of the structure responsible for the schiller

* An earlier article on the Iridescent Feldspars appeared in *Current Science* for October, 1950, **19**, 301-05 see also, *Proc. Ind. Acad. Sci.*, 1950, **32A**, 1-16 and 123-40.

are well beyond the power of a microscope to resolve even in the most favourable circumstances. Indeed, one may say that, *macroscopically considered*, the Ceylon moonstones, like labradorite, are essentially monocrystals, and that the diffusion of light which they exhibit is a consequence of local fluctuations of composition and refractive index. The analogy with the well-known optical behaviour of liquid mixtures of which the components are only partially soluble in each other naturally suggests itself in this connection.

The account of the subject given in an earlier article in *Current Science* was deliberately made brief, as it was intended to follow it up by a fuller account when our investigations had progressed further. Much new material has meanwhile come into our hands. Besides the specimens of uncut moonstones from Ceylon presented by Mr. Punnyasoma, we have now some fifty-eight cut and polished specimens of the same material, the optical behaviour of which is a fascinating study (Fig. 1). Prof. Ito of the Mineralogical Institute of Tokyo has very kindly sent us a collection of small but beautifully crystallised moonstones from Korea. Through the kindness of Prof. T. N. Muthuswamy of Madras, we have received a collection of quite large pieces of plagioclase feldspar from Gudur in South India which show a blue or bluish-white iridescence. Some kind friends also enabled me to visit the pegmatite areas in the Coimbatore District in South India, and bring back with me a collection of specimens of orthoclase feldspar exhibiting a golden-yellow schiller. When all this material has been properly studied, there should be quite a good story to tell.

In our earlier studies on the behaviour of labradorite and of the Ceylon moonstones, the technique adopted was that of illuminating the entire specimen with a beam of light and of observing or photographing its whole area from different view-points. We have since found that for many purposes, it is advantageous to adopt a somewhat different technique, in which *a small area* of the specimen is illuminated by a narrow intense beam of light and the radiation diffused by it is received on a white screen held at not too great a distance. The distribution of intensity of the light diffused in various directions can then be simultaneously observed. By traversing the specimen across the incident pencil of light, or by altering the tilt of the specimen with respect to its direction, one can quickly study the changes in the pattern of diffused light resulting therefrom. The observations should preferably be made in a dark room. The more intense the incident pencil of light is, the more striking are the effects observed. It is necessary, of course, to eliminate effects arising from refraction or scattering at

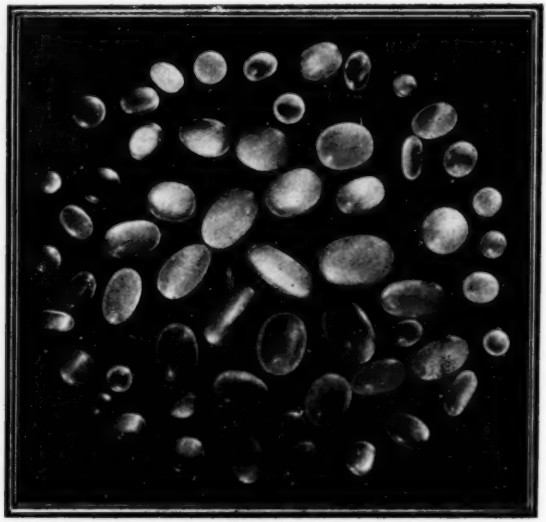

FIG. 1

A Collection of Ceylon Moonstones

the external surface of the specimen. This may be done by immersing the specimen—if it be not too large—inside a glass cell containing a transparent liquid of suitable refractive index

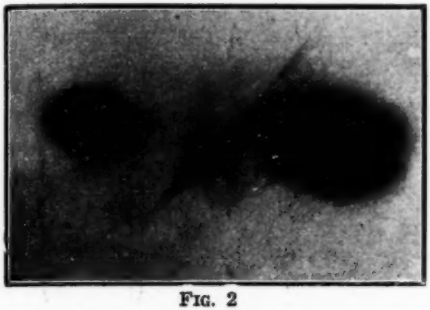

FIG. 2

The Diffusion Pattern of Labradorite

and traversed by the incident pencil of light. With large specimens, on the other hand, if the external surface is polished, no such immersion is necessary. But if the surface be rough, the scattering may be eliminated by spreading a little Canada balsam and covering it with a strip of glass. The diffusion pattern may be conveniently photographed by receiving it directly on a piece of bromide paper.

while the two elliptic patches, one on either side, represent the characteristic iridescence of the labradorite. These two patches have their origins respectively in the alternate layers of the albite twinning which is very common in the plagioclase feldspars.

With the Ceylon moonstones, we invariably observe only one elliptic patch of diffused radiation. This has a very large area in the case of the specimens exhibiting a blue schiller, a smaller area in the case of those showing a bluish-white schiller and the smallest area with the moonstones giving a white schiller (Fig. 3). From the dimensions of these patches of diffused light, it is possible to determine the linear extension in the different directions of the heterogeneities of structure responsible for the observed effects. We may mention that we have also used the same method of observation for the study of other species of iridescent feldspar. For instance, the Korean moonstones show usually only one, but sometimes two, and occasionally four separate diffusion patches, arranged with tetrahedral symmetry about a common direction. There is visible evidence that the crystals in these latter cases are not simple but twinned. Finally, one should make mention of the fact that the method of obser-

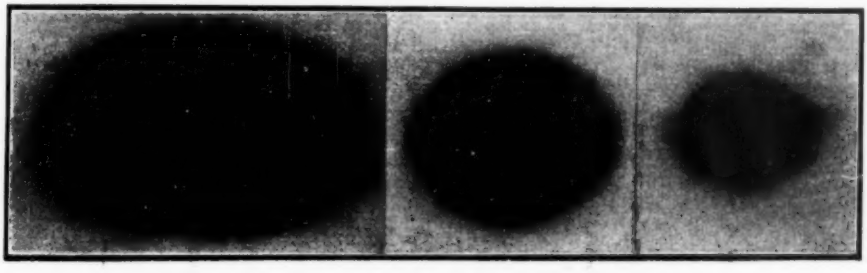

FIG. 3

Diffusion Patterns of the Ceylon Moonstones

(*a*) Blue Schiller, (*b*) Bluish-White Schiller (*c*) White Schiller

As a method of demonstrating the origin and characters of the iridescence, and exhibiting the relations between the phenomenon and the crystal orientation, and the influence of the disposition of the twinning layers (if any) present in the specimen, the technique described above is extremely convenient. This remark is illustrated by Fig. 2 which shows the diffusion pattern of one of our specimens of labradorite. The central black spot in the picture is the record of the "aventurine reflection" due to the Fe_2O_3 crystals included in the labradorite,

vation described can be used, not only for the study of the schiller effect properly so called, but also of the diffusion of light in other directions, *e.g.*, in directions not far removed from that of incident light beam. Very striking phenomena are observed in certain cases in such directions. But we have not space here to refer to them.

In the development of the new method of observation here described, my collaborators, Messrs. A. Jayaraman and T. K. Srinivasan, have played a notable part.

LOCUSTS AND GRASSHOPPERS

HEM SINGH PRUTHI

(Director, Locust Control and Plant Protection Adviser to the Govt. of India, New Delhi)

FROM the report published in *Nature*, Vol. 166, No. 4224, October 1950, of the symposium on Locusts and Grasshoppers, held at the recent meeting of the British Association (Zoology Section) at Birmingham, it appears that Dr. Uvarov, Director, Anti-Locust Research, London, who opened the discussion, and other speakers kept mainly Africa in view in their appraisement of anti-locust work. The Desert Locust, which admittedly has outbreak areas extending over about 25 countries in Africa, Ariabia and south-west Asia, is the most important locust in India. Considerable work has been carried out on this locust on the Indian sub-continent during the past 20 years or so, and very appreciable progress has been made both in technical and organizational work for its control. Moreover, international collaboration between various countries in south-west Asia has reached a fairly high level. Therefore, a brief account of the work carried out in this region during the past 25 years is likely to interest those interested in locust problem. Moreover, a symposium on an international pest like the locust will be inconclusive if a very important region of its activity is ignored.

During the 1926-31 cycle, the Government of India (then undivided) established a Locust Bureau for the proper supervision and co-ordination of anti-locust work in the country. On account of rush of control work during the cycle, adequate attention could not be paid to research work; but in 1931, when the cycle declined, the Indian Council of Agricultural Research set up an organisation (under Mian Afzal Hussain) for work on the biology and ecology of the Desert Locust. The work was divided into two units, one for laboratory research with headquarters at Lyallpur and the other for research in the field with headquarters first at Quetta and subsequently at Karachi (with Y. Ramachandra Rao in charge). These research units carried out for about ten years several detailed investigations and collected very important and valuable information, the results of which have been published in several periodicals in the U.K. and in India. All the suspected outbreak areas were properly mapped, seasonal fluctuations in locust population in different regions of the country were recorded and it was shown for the first time that migrations of locusts of the solitary phase were similar to those of swarms. Conditions under which locusts acquire gregarious characters in large field cages and laboratory were studied. Many other problems discussed at Birmingham were also posed and investigated.

In 1939, the Government of India established a Locust Warning Organization on a permanent basis. Its functions included further study of locust ecology in the outbreak areas and of changes in locust population and phases under different conditions, control of incipient swarming, forecasting of developments in locust activity, etc.

In the summer of 1940, a fresh locust cycle started in India as in other countries in the locust belt. A control wing was added to the Locust Warning Organization for organising control operations in all the desert breeding areas of the country irrespective of state or provincial boundaries. Under a Co-ordinated Anti-Locust Scheme, all the crop areas which were to derive benefit from the campaign against the locust in its desert homes willingly agreed to share the expenditure incurred in the desert breeding areas. The Head of the Central Organization (the writer) was responsible for an overall supervision of the control work in the target areas also and he kept himself fully acquainted with the work of similar organizations in the neighbouring countries. The result of work thus co-ordinated was that for the first time in history, control operations were so successful that crops worth crores of rupees escaped from any appreciable damage throughout the World War II, when food supply was really very difficult. From a technical viewpoint, though India was invaded by swarms coming from Western countries every summer, it is noteworthy that even during the peak years of 1943-46 extremely few swarms indeed went in the opposite direction in the autumn. It may be pointed out in this connection that the number of swarms which come into India from the western direction during the summer depends on the adequacy of control measures in Baluchistan and the Middle East countries, and perhaps beyond, where locust breeding takes place during spring in the wake of winter rainfall. Similarly if work in the summer breeding areas of India (and Pakistan) is not successful, swarms develop, some of which fly

towards the west in the autumn, while others penetrate into the interior of the country and may reach Bengal and Assam in the east, and Madras in the south. The success of the work carried out in India was fully appreciated at several international conferences, *e.g.*, Tehran, Cairo, Karachi, etc. Of the Karachi Conference (November, 1943), when representatives from the U.K., USSR and some Middle East countries were also present, the main object was to assess the extent of swarm migrations which might be expected from India to the Middle East countries during that season. It was concluded that chiefly on account of the adequate work carried out in India during the past summer, the migration, if it materialised at all, would be on extremely small scale. Actually no swarm crossed into Iran and Arabia during the season. In view of this, one is justified in considering that the anti-locust campaigns carried out in India during World War II were perhaps more successful than those in Africa and the Middle East—the only countries mentioned at the symposium at Birmingham.

As regards international collaboration, India was the first country to send a locust mission to Iran in the spring of 1942. In 1943 and subsequent years of the cycle, Indian parties worked not only in Persian Mekran but in eastern Arabia also. Fortnightly, monthly and annual reports on locust work carried out in India and by the Indian missions in the adjoining countries were sent regularly to all the countries interested in locust control and to the Anti-Locust Research Centre, London, which was kept informed of major developments even by cables.

With the establishment of Pakistan in 1947, the Indian Locust Warning Organisation was divided on regional basis but the two organisations are working on the sub-continent in collaboration. As a matter of fact, an Anti-Locust Convention has been in force since August 1947 for international collaboration between India, Pakistan and Iran. Representatives of the three countries meet frequently for exchange of information and experiences, and formal conferences are held annually in different countries by turn. With the outbreak of another cycle during 1949, the three countries have jointly assisted in the control operations in Oman and Trucial coast of Eastern Arabia. Technical experts of other governments interested in the desert locust are also invited to the annual conferences. For example, about a dozen nations including the U.K., France, USSR, Egypt, various Middle East Countries, Afghanistan, etc., were invited to the International Anti-Locust Conference held in New Delhi in November last. The F.A.O. also sent their expert. Some of these countries attended a conference of this kind for the first time and it is gratifying that the level of international co-operation was raised still higher.

While directly connected with the anti-locust work in India, the writer has been in close touch also with the locust situation in other countries during the past 16 years. Reviewing the position in the desert locust belt as a whole, it appears that considerable progress is necessary in the most essential work of mapping the outbreak areas on the African and Arabian continents. In the vast majority of countries permanent national organizations have to be set up, which alone can do such work adequately and economically. On the African continent, this should not be so difficult because many of the countries are under the control of enlightened Western powers such as U.K., France, Spain, Italy, etc. The work in Egypt and the Anglo-Egyptian Sudan is already of a high order. The Desert Locust Survey which was established in 1948 by the U.K. with headquarters in Nairobi, of which the functions are similar to the Indian Locust Warning Organisation set up in 1939, has made extensive surveys in the east African countries and in the neighbouring parts of Arabia. As is the practice during outbreak periods in India since 1942, a control wing called Desert Locust Control has also been recently set up for organising control campaign in the countries in the charge of U.K. Organisation. It is hoped that during this cycle, which is very serious, other countries will also establish similar organizations and it will be possible to raise the standard of international collaboration on the African and the Arabian Continents, which will go a long way in the establishment of overall co-operation between all the countries affected by the locust and in the further elucidation and solution of locust problem. In science, as in other spheres of human activity, international co-operation must be based on international understanding and appreciation of one another's contributions towards the common objective.

THE EFFECT OF HYDROGEN ON STEEL AND FORMATION OF HAIR-LINE CRACKS

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(National Metallurgical Laboratory, Jamshedpur)

ALL available evidence indicates that hydrogen is essential for the formation of hair-line cracks. Thus, Cramer and Bast[1] treated steel with hydrogen and found that this element played an important part in the development of flakes. Musatti and Reggiori[2,3] found no segregation of nickel or chromium at the flakes by chemical and microscopic studies. Andrew and co-workers[4] and Cramer[5] produced hair cracks after heating the specimens to 1200 deg. C. soaking in hydrogen, quenching in water, and ageing at room temperature for at least 24 hours. This incubation period was previously noticed by Klausting.[6] The cracks developed spontaneously after the incubation period. Specimens soaked in nitrogen did not develop these cracks. Andrew, *et al.*[7] found that alloying elements have little, if any, effect upon the diffusion of hydrogen in steel. The evolution of hydrogen was maximum at the end of the thermal transformation. Presence of hydrogen not only leads to formation of cracks but also affects mechanical properties. There is an embrittling effect for hydrogen content from 1-3 c.c./100 g. Cracks appear even in the absence of transformation stresses. Although no cases were observed of internal crack formation in the absence of hydrogen, certain specimens showed no cracks in spite of high hydrogen content. This is confirmed by Sykes, Burton and Gegg.[8] They found that a softening treatment renders the material immune to crack formation when air cooled from the austenitic condition. They demonstrated that transformation stresses, quenching stresses and the presence of hydrogen are additive in producing cracks, and that hydrogen rich materials are more susceptible. But it is found that slow cooling helps in preventing the development of flakes.[1,8,9,10,11] Houdremont and Korschan[12] showed that the rate of cooling through the range of about 200 deg.C. is important, since gaseous hydrogen separates from solid solution then. Andrew, *et al.*[13] noticed an increase in rate of hydrogen evolution at the $\gamma \rightarrow \alpha$ transformation and elements which lower this change in steel were found to retard the evolution of hydrogen. The hardness and microstructures of nitrogen and hydrogen-soaked specimens were, however, found to be identical. These observations suggest that attention must be paid to the following factors[25] to eliminate hair-line cracks: (*a*) H_2 content of liquid steel; (*b*) segregation in the ingot; (*c*) refining of the structure by heat-treatment; and (*d*) removal of transformation stresses.

Methods for determining hydrogen in steel have been developed by Iwase and Fukusima,[14] Hare, Peterson and Soler[15] and described in a Symposium published in the *Trans. AIME* (1945, 162, 353).

A few earlier authors have also attributed other causes for the formation of hair cracks, *e.g.*, the difference in concentration of carbon and chromium in chromium steels[16] and crystal segregation.[11,17] Schall[18] believed that shatter cracks formed after the last reversal in internal stress during cooling nearly at room temperature.

Regarding the mechanism of the crack formation, Honda and Hirone[19] showed that the pressure exerted by the evolution of hydrogen, combined with thermal and transformation stresses, suffice to form the flakes. Guichard, Clausmann and Billon[20] reported that hydrogen formed water vapour with oxides instead, thus developing enough pressure to form flakes. According to Zaffe and Sims,[21] who assume a 'block' structure, hydrogen remains occluded in interblock disjunctions under pressure, and when this pressure exceeds the elastic strength of steel, cracks are formed. Andrew, *et al.*[13] suppose these disjunctions to be misfits in the lattice, which could accommodate one molecule of hydrogen which is sufficient for the purpose. On this basis, Andrew and Lee[22] suggested that the variation of the size of mosaic blocks may account for the different response of steels of different compositions and treatments to hair-line crack formation. The disruptive pressure of methane formed from carbide by atomic hydrogen[13] is also another possibility.

Based on experimental results, Zapffe[23,24,25,26] put forward a strong evidence in favour of "Planar-pressure theory". According to this concept, hydrogen embrittlement is nothing other than the result of an ageing action in which the precipitate is a gas and is inconsis-

tent with concepts based on lattice distortion or compound formation.

It is thus observed that slow cooling appears to be beneficial in preventing hair-line crack formation, the fundamental cause of which is presence of hydrogen in steel. But no wholly acceptable theory has been put forward to account for the phenomenon.

1. Cramer, R. E., and Bast, E. C., *Trans. A.S.M.*, **1939, 27, 433.** 2. Musatti, I., and Reggiori, A., " VII, Int. Congr. Mining, Metallurgy and Applied Geology, Paris," *Rev. de Met. Memoires*, 1935, **32,** 532. 3. Musatti, I., and Reggiori, A., *Metal Progress*, 1936, **30,** No. 6, 52. 4. Andrew, J. H., *et al., J.I.S.I.*, 1942, **2,** 193. 5. Cramer, R. E., *Trans. A.S.M.*, 1937, **25,** 923. 6. Klausting, *Metallurgy*, **1937, 12, 21.** 7. Andrew, J. H., *et al., J.I.S.I.*, 1946, 2, 67. 8. Sykes, C., Barton, H. G., and Gegg, C. C., *Ibid.*, 1947, **156,** 155. 9. Hultgren, A., *Ibid.*, 1925, **1,** 113. 10. Service T. M., *Royal Tech. Met. J.*, 1929-30, **7,** 9. 11. Eilsender, W., and Kiesster, H., *Zad Vereins Deutsch. Ing.*, **1931, 76,** 729. 12. Houdrement, E., and Korschan, H., *Stal and Eisen*, 1935, **55,** 297. 13. Andrew, J. H., *et al., J.I.S.I.*, 1947, **156,** 208. 14. Iwase and Fukusima, *Metals and Alloys*, April 1938. 15 Hare, W., Peterson, L., and Soler, G., *Trans. A.S.M.*, 1937, **25,** 889. 16. Aichholzer, W., *Stal und Eisen*, 1928, **18,** 1332. 17. Bardenhever, P., *Mitt. Kaiser Wilhelm Inst. fur Eisenforsch.*, 1925, **7,** 1. 18. Schall, *Archiv fur das Eisenhuttenwesen*, 1935, **8,** 309. 19. Honda, K., and Hirone, T., *Sci. Rep. Tohoku Imp. Univ.*, 1936, **25,** 713. 20. Guichard, Clausmann and Billon, *Chemie und Ind.*, 1934, **31,** 588. 21. Zaffe, C. A., and Sims, C. E., *Trans. A.I.M.E.*, 1941, **145,** 225. 22. Andrew, J. H., and Lee, H., *J. Inst. Metals. Symp. on Internal Stresses in Metals and Alloys* Oct. 1947. 23. Zapffe, C. A., *Metal Progress*, 1949, **42,** 209. 24. —, *Ibid.*, 1942, **42,** 1051. 25. —, *Ibid.*, 1943, **43,** 397. 26. —, and Moore, G. A., *Trans. A.I.M.E.*, 1943, **154,** 335.

RECENT PROGRESS AT THE INDIAN INSTITUTE OF SCIENCE, BANGALORE

IN the course of his Welcome Address to President Rajendra Prasad, and the First Visitor of the Institute under the new Constitution, Prof. Thacker, Director, reviewed the recent progress of the Institute and outlined its future development. He said: "The spirit of research wedded to the cause of raising the economic and social standard of our country has been the ideal which has all along been followed by our workers in their endeavour and, I hope, that this spirit which has been imparted to this Institute by its Founder will be pursued in the future also in an ever-increasing measure.

Till 1940, there were only the Departments of Physics, Chemistry and Electrical Technology in this Institute. In 1941 with the help of funds made available by the Government of India, the Department of Aeronautical Engineering was started in recognition of the part that aviation would play both in times of war as the backbone of a country's defence and in times of peace as a speedy mode of communication. Shortly thereafter a deputation led by our President of the Court and Chairman of the Council, Sir Vithal N. Chandavarkar, waited upon the Government of India with a four-year programme of development of the activities of this Institute. The scheme which gained ready support was inaugurated in 1946. Under this have been established the Departments of Metallurgy, Internal Combustion Engineering and Electrical Commuication Engineering, which are now doing good work. The activities of the older Departments have been expanded and laboratories for research in Food and Fermentation Technology and Pharmacology added to the Department of Biochemistry. Provision was also made for background training in Economics and Social Sciences to young technologists, and for the deputation of selected members of the staff to the U.K., the U.S.A., and Europe for getting acquainted with the latest advances in their particular spheres of work.

At its annual meeting held in 1945, the Court again laid emphasis on the need for the provision of facilities for post-graduate study and research in Heavy Engineering, Power Engineering and the Designing of Machinery in view of the post-war plans for the proper development of the resources of the country. A Committee of Experts drew up a Scheme for the establishment of a Department of Power Engineering which was approved by the Government of India and work for the starting of the Department was commenced towards the end of 1947, the entire cost of this Scheme being met by the Government of India.

The object of this Department* is to provide instruction to engineering graduates of Indian Universities in Power Engineering (Hydro-electrical and thermal) for a period of two years, including a period of specialised practical work outside, so that when they emerge from this course they should be able to take up immediately and discharge with confidence superior responsibilities.

In view of the very little scope for research in engineering and very little engineering research being done in India at present, research would also be given due importance and receive prominence as the Department progresses.

Also, it was resolved by the Standing Advisory Committee to request the Government that a grant which may be earmarked for a Hydraulic Machines Laboratory Wing in the Ministry of Natural Resources and Scientific Research be diverted to this Department, as such diversion resulting in a co-ordination of effort would be in the best interests of the country.

Mutual co-operation and friendly collaboration between scientific institutions and industrial establishments are of extreme value both to science and industry. This Institute has all along been playing its part in establishing such a liaison with industry; and its main objective has been the fostering of investigations especially in those branches of science as would assist industries by providing them with the results of research which they need. In the Western countries, applied research is a charge on the industries which it serves; and it is time that in India too the industries recognise the need to support technological and research institutions."

* The Power Engineering and High Voltage Engineering Laboratories of the Institute were declared open by the President on this occasion.

ORIGIN AND DISTRIBUTION OF CULTIVATED PLANTS IN SOUTH ASIA

A SYMPOSIUM on the above subject was held in Delhi from 12-15 January 1951, by the Indian Society of Genetics and Plant Breeding with the co-operation and assistance of the UNESCO South Asia Science Co-operation Office. The purpose was to review the work done so far on the taxonomy and cytogenetics of crop plants, with a view to stimulate further study. Professors S. C. Harland (Manchester), Edgar Anderson (Washington), and A. Muntzing (Lund), were present by invitation. Delegates from Academia Sinica, Peking, workers from Ceylon, Singapore and Pakistan also attended. There were also observers from various other scientific bodies and institutions.

Mr. K. Ramiah, Director, Central Rice Research Institute, Cuttack, was elected Chairman; and discussion on the following subjects took place.

12*th January*: Rice, wheat, banana and mango; 13*th January*: Citrus, sugarcane, millets, brinjal and orchids; 15*th January*: Cotton jute, sesame, spices, palms. Each day, the session began with an introductory talk by one of the expert consultants, who dealt with general and theoretical aspects of the subject, and expounded particular lines of work which had proved to be of practical value. The papers on each crop was followed by a discussion.

The complete proceedings are to be published soon by the Indian Society of Genetics and Plant Breeding, copies of which may be had from the Secretary of the Society, Indian Agricultural Research Institute, New Delhi.

Besides the much needed review of cytogenetics of economic plants, the symposium brought out some important points which would be of value for any long-range programme for improvement of crop plants, such as: (1) organising a Bureau of Plant Introduction, (2) setting up a Committee for Plant Exploration in Indo-Malayan region, and (3) intensifying study of plant taxonomy and cytogenetics in botanical research centres.

C. G.

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A HISTORICAL NOTE ON A THEOREM IN INCOMPLETE BLOCK DESIGNS

A THEOREM in incomplete block designs first glimpsed by the author partially in 1946[1] has been completed by Schützenberger in 1949[2] and his proof has been improved upon by Chakrabarthi in 1950.[3] The aim of this note is to put these results in their historical perspective and also to indicate a method of proving them without vector notions, but using the matrix representation of a block design mentioned by the author in 1943.[4]

The symbols v, b, r, k in this note will be used in the sense of Fisher and Yates in connection with balanced incomplete block designs. $d = (r-\lambda)$ where λ is the number of elements common to any two sets in a block.

The theorem proved in 1946[1] is: "A necessary condition for a cyclic solution to exist is that $(r-\lambda)$ should be a perfect square when v is even. Hence a difference set cannot exist when v is even and $r-\lambda$ is not a perfect square, *e.g.*, $v = b = 46$, $r = k = 10$, $\lambda = 2$." This is quoted by Bose[5] who adds that for the above design which is yet unsolved, at least no cyclic solution can exist.

Schützenberger has completed the theorem and shown that if v is even, a symmetrical design can exist only if $r - \lambda$ is a perfect square. But his proof involves complicated methods. The shorter proof of Chakrabarthi also includes orthogonal vectors and Laplacian expansion for determinants.

The result can be proved with the help of the author's matrix representation, which has also been used by Schützenberger, and a lemma recognized by Chakrabarthi. Let the matrix (pq) represent the configuration of v elements and b sets, p being the index number of a set and q the index number of an element contained in a set, the sets and elements being numbered in any manner consecutively. The dual configuration can be represented by the transposed matrix (qp). The proof of the following theorem is then straightforward:

"If a_{ij} be the number of elements common to the ith and jth sets of an incomplete block design, each element occurring in r blocks and each pair of elements in λ blocks, then the square matrix of b rows formed of the elements, a_{ij}, is the product of the marix (pq) of b rows and v columns and its transpose (qp) of v rows and b columns where we write 0 in the empty spaces of the matrices and 1 in the occupied spaces."

Consider the determinants derived from the matrices, where the necessary number of zero rows or zero columns are added if $b \neq v$ to make it square. Hence, $|a_{ij}| = 0$ if $b \neq v$ and a_{ij} is a perfect square if $b = v$.

In the case of the symmetrical block design, $a_{ij} = \lambda$ $(i \neq j)$ and $a_{ii} = k = r$ and in the other case, at least two a_{ij}'s are unequal. The proof of this and also of the relation $v \leqslant b$, is obvious from the following identity proved by the author,[4]

$$\Sigma (a_{ij} - a_{ik})^2 = (k-1)(r-k)(r-\lambda)^2 \leq$$

where i is fixed and j, k run over all values except i not exceeding b. The value of the determinant $|a_{ij}|$ in the symmetrical case is a particular case of that given by Salmon[6] and can be shown to be equal to $r^2 (r-\lambda)^{v-1}$.

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Andhra University,
Waltair,
January 14, 1951.

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RAMAN SPECTRUM OF APOPHYLLITE

APOPHYLLITE ($KF\,Ca_4\,Si_8\,O_{20}\cdot 8H_2O$) is unique among the silicates in that it bears a close resemblance to the micas in its structural characteristics, while like the Zeolites it is capable of giving off its water-content on heating and reabsorbing it on cooling. Only a study of the dehydration curve and the optical anomalies exhibited by apophyllite are on record. If Pauling's rule is to be obeyed, the water content in this crystal has to be incorporated as HO-H-O groups rather than in the customary way. This seems to be corroborated by the appearance of only one high frequency shift Raman line in its spectrum.

The Raman spectrum of a natural specimen of apophyllite was photographed using the λ 2537 radiation of a quartz mercury arc as exciter. The incident light was normal to the (001) cleavage face, while the scattered light was gathered edgewise along [100] direction. Its spectrum consists of 19 lines with frequency shifts 90 (1), 108 (3), 138 (2), 166 (1), 187 (1), 209 (2), 232 (1), 280 (1), 307 (2), 344 (2), 355 (1), 433 (1), 488 (2), 541 (2), 586 (2), 820 (1), 1080 (5) and 3520 (10), the first 18 of which are reproduced in the accompanying figure. It is found that while the lines 90, 166, 209, 232 are depolarised, lines 108, 138, 187, 1080 and 3520 are strongly polarised when unpolarised light is incident along the optic axis and the scattered light is taken normal to the (100) cleavage face.

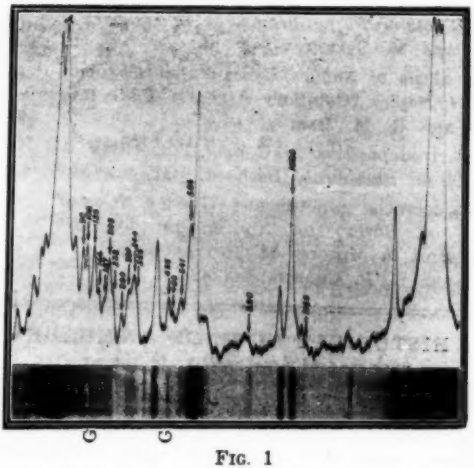

FIG. 1

(*a*) Raman Spectrum of apophyllite taken with λ 2537 excitation.
(*b*) Its Microphotometer record.

The structure of apophyllite is based on linked silicon oxygen sheets of a tetragonal type, the adjacent sheets being linked by cations (Ca, F and K) on reflection planes. A calculation of the possible number of vibrations of the different symmetry types of the two molecules contained in the unit cell show that as many as 103 frequencies may be expected to appear in Raman effect. Also in the particular orientation studied, all except the 41 frequencies of the degenerate class E should be fully polarised and as such a tentative assignment can be made as given below.

Symmetry type	A_{1g}	B	E_g
Frequency observed	3520	108, 138	90, 166, 209
	1080	187	232

The author is grateful to Prof. R. S. Krishnan for suggesting the problem.

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March 14, 1951.

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SCHILLER IN MOONSTONE

I HAVE read with interest the article on the above subject in the October 1950 issue of *Current Science* and also the original paper referred to therein.[1] Some of their references are to earlier work carried out by me, and as I cannot fully subscribe to the interpretations or the conclusions arrived at, I would welcome this opportunity to discuss these in your journal.

I. *Schiller Plane or Schiller Axis.*—The schiller plane of the potash-soda moonstone felspars has been measured by a number of workers[2] (and see reference therein pp. 309-10). The values obtained by them vary between the angles of 72° and 75°·5 as measured on the trace of 001, the plane cutting the *c*-axis negatively and being perpendicular to 010. The mean value obtained by me for Ambalangoda moonstone was 73°·53′ and with $\beta = 63°·57'$ the plane thus makes an angle of 9°·56′ with the *c*-axis. Raman, Jayaraman and Srinivasan prefer to make use of the schiller axis, *i.e.*, the normal to the schiller plane. They give the direction of this schiller axis as 81° to the *c*-axis and state that the schiller plane makes an angle of 9° with 100 that is with the *c*-axis. In view of their cursory reference to other determinations of this schiller plane, it is surprising that no information is supplied as to how their own measurements were made. Moreover, without qualification their figure of 81° to the *c*-axis is ambiguous as it includes two arbitrary directions. However, it is fairly certain that the direction obtained by them is in the same sense as that of previous workers, i.e., that the schiller plane cuts the *c*-axis negatively. If this is the case, their value of 9° is very close to the figure of 9°·56′ obtained by me. The difference is probably well within the limits of their experimental error. Again, within the limits of experimental error, *this plane is identical with the mean plane in which the micro- and crypto-perthitic structures lie in these potash-soda moonstone felspars*, as measured by various workers.

II. *Micro- and Crypto-Perthitic Structure and Schiller.*—Raman, Jayaram and Srinivasan discount the suggestion that the schiller of these blue and white moonstones is connected with the perthitic structure, stating "the coarse structure of which indications are observed under low powers of the microscope in certain other cases is *prima facie* incapable of giving rise to the optical phenomena under consideration". But is this the case? The micro- or crypto-perthitic structures described and photographed by me[2] (pp. 302-12 and plates) in the blue-white Ambalangoda moonstones show lamellæ ranging in thickness from ·001 millimetre downwards the majority lying between ·001 and ·0005 millimetre. Now ·0005 millimetre is below the wave-length of the middle part of the visible spectrum, and it will be evident from the description referred to above that this value cannot represent the lower limit of thickness of these lenses or films. These lamallæ are not flat plates as the writers apparently assume them to be, but are in reality flattened cigar or pencil-shaped bodies tapering away at the edges. Their length—in the plane of 010—is roughly 50 times and the breadth—along the *b*-axis—is about 10 times the mean thickness. They tend to finger off in the *b*-axis direction along prism planes.

I submit that these dimensions are of a much lower order than that indicated by the above quotation and that they lie within the limits required for producing the blue to white schiller by the scattering and reflection of light by these bodies.

The writers make a strong point of their observation that the schiller range is several times greater when measured on the *c*-axis of rotation than when *b* is the rotating axis. I submit that this is precisely what one would expect if the schiller is due to the minute lenticular bodies described above, with a length much greater in a direction perpendicular to the *b*-axis than is their breadth parallel to this direction.

The fact that moonstones with white schiller show relatively coarser and more sharply defined micro- and crypto-perthitic structures would also follow from the increasing proportion of the visible spectrum scattered and reflected by these minute bodies.

It may be said that of the many hundreds of transparent or semi-transparent micro- and

crypto-perthitic soda-potash felspars which I have examined under the microscope not one has failed to display a schiller, either blue, blue-white or white. The same applies to those micro-perthitic microclines sufficiently clear or translucent along the *a*-axis direction to permit of internal reflections.

III. *X-Ray Heterogeneity.*—Raman, Jayaraman and Srinivasan agree with previous investigators that these Ambalangoda moonstones show X-ray heterogeneity although they draw attention to a paper by Chao and Taylor[5] in which "certain specimens of moonstone show a faint schiller but give no trace of additional X-ray reflections".

This paper discusses the X-ray examination of eleven potash-soda felspars supplied by me to Taylor. Eight of these specimens show blue or white schiller and only the one lowest in soda, namely, specimen D with a faint blue schiller, definitely fails to show a double X-ray pattern, with the next specimen on the list, namely E, doubtful. These two specimens contain only 14% and 16·5% of soda felspar respectively as against 30 to 40% in Ambalangoda moonstone. Yet both of these show micro- to crypto-perthitic structures under the microscope with optimum illumination conditions, specimen D faintly and specimen E fairly strongly. I have recently confirmed my original observations from portions of these specimens still in my possession. Of the remaining six specimens which show definite X-ray patterns and micro- to crypto-perthitic structures, two are Ambalangoda moonstones.

IV. *Apparent Monoclinic Character of the Soda-Potash Felspars.*—Reference is made by the writers to a paper by Ito[6] in which the segregation of the soda felspar component in moonstone is stated to be such as to make a near approach to the structure and symmetry of orthoclase. This apparent monoclinic character, even with relatively coarse perthitic moonstones was pointed out by me as early as 1930[2] (p. 306) and discussed in later papers[3] (p. 485) and[4] (pp. 88-89). Monoclinic symmetry could be simulated by twinning of the triclinic soda felspar component, but the micro-perthitic schillerised potash-soda felspars show no visible evidence of twinning and their behaviour towards heat treatment indicates that the soda felspar component is different from true albite.

E. SPENCER.

February 9, 1951.

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THE STRUCTURE AND OPTICAL BEHAVIOUR OF THE CEYLON MOONSTONES*

I. THE visual observations described in our paper under this title, and the photographs reproduced in an article appearing in the present issue of *Current Science* prove that the schiller exhibited by the Ceylon moonstones is very far indeed from being a geometric reflection of light within the crystal. Actually, it is a diffusion of light visible in all directions, the greater part of the energy diffused being, however, concentrated within a fairly defined area extending over several degress of arc each way. The distribution of intensity in these diffusion patterns and the manner in which the patterns shift with the setting of the crystal are most conveniently described in terms of the "schiller axis" which is a particular direction within the crystal. Since there is no geometric reflection, the "schiller planes" are purely hypothetical and the use of the term to describe the phenomena seems to us to be misleading.

II. From a study of the shape and angular extension of the observed diffusion patterns, well-understood principles of optical diffraction theory enable us to deduce the linear extension of the elements in the heterogeneous structure responsible for the diffusion of light. Table I gives the average values determined by us in this way from a study of numerous specimens.

TABLE I

Colour of the Schiller	Major axis	Minor axis
Blue ..	1·6 μ	0·8 μ
Bluish-white ..	3·0 μ	1·6 μ
White ..	6·0 μ	5·0 μ

The lengths shown in the second and third columns of Table I are transverse to each other and to the direction of the schiller axis. The maximum difference in refractive index arising from the local variations of chemical composi-

* Our paper under this title appeared in *Proc. Ind. Acad. Sci.*, 1950, **32**, 123-40.

The paragraph numbering in the present note follows that appearing in Dr. E. Spencer's letter to which it is a reply.

tion of the feldspar is of the order of 0·01. Multiplying this by the lengths shown in Table I, it is seen that the optical path-differences arising in the passage of light through an *individual* element in the structure would, in all cases, be only a small fraction of the wave-length of light. One has also to consider the confusion arising from the overlap of the phase-differences due to the elements successively traversed by the light. In these circumstances, it does not seem possible that the heterogeneity of structure actually responsible for the schiller effect would visibly manifest itself under the microscope.

The structures observed by Dr. Spencer under certain conditions of illumination and under low powers of the microscope have dimensions ranging from 50 μ downwards in one direction and from 10 μ downwards in the transverse direction. These are far larger than the sizes indicated by the diffusion patterns and shown in Table I. The remark made by us in our paper that such structures are *prima facie* incapable of giving rise to the optical phenomena under discussion seems to us in the circumstances fully justified.

III. The features of the structure which are responsible for the appearance of the optical diffusion patterns studied by us are presumably also responsible for the observed peculiarities in the X-ray patterns. We make this statement with due reserve, since, as stated in our paper, further investigations are necessary to establish the correctness in a conclusive manner.

IV. Prof. Ito states clearly in his paper that the structure of the Korean moonstones studied by him is beyond the resolving power of a microscope. The samples of the material which he has kindly sent to us are beautifully crystallised and transparent specimens. We see no reason to believe that either the schiller which they exhibit or the special features observed in their X-ray patterns arise from coarse structures of the kind found in the micro-perthitic feldspars.

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April 14, 1951.

RELATION BETWEEN BOND COMPOSITION AND CRUSHING STRENGTH OF SAND LIME BRICKS

THE bond in sand lime bricks is mainly made of 3 $CaOSiO_2$ and 15 $CaO\ Al_2O_3\ 5\ SiO_2$. An empirical formula shown below gives roughly the relation between the nature and composition of the bond and crushing strength of the brick.

Crushing strength in lb./sq. in = 400 T.S. + 720 A.S., where T.S. and A.S. represent the percentages of lime in the aggregate present as tricalcium silicate and calcium aluminosilicate respectively.

Bricks were made using pure lime and sand under a pressure of 2 tons per sq. in. and steamed for 8 hours at a pressure of 100-125 lbs./sq. in. The time lapse between the determination of the crushing strength and the preparation of the brick was ordinarily about 15 days. The crushing strength of the bricks progressively increased with increase in the proportion of lime. Assuming that whole of lime is present as tricalcium silicate the crushing strength according to the formula is equal to 400 × percentage of lime. Both the calculated and observed values are given in Table I and show fair agreement.

TABLE I

%Lime in aggregate	Crushing strength in lb./sq. in.	
	Observed	Calculated
5	1942	2000
6	2391	2400
7	2693	2800
8	3158	3200
12	4894	4800

Venkatesham[2] prepared superior quality sand lime bricks using sludge after extraction of potash from felspar mixed with suitable amount of sand and water. The work under progress[3] in these Laboratories leads us to conclude that calcium oxide reacts with felspar according to equations I and II:—

$$K_2O\ Al_2O_3\ 6\ SiO_2 + 20\ CaO = K_2O + 6\ (3\ CaO\ SiO_2) + 2\ CaOAl_2O_3 \qquad (I)$$

$$5\ (3\ CaO\ SiO_2) + 2\ CaO\ Al_2O_3 + x\ SiO_2 = 15\ CaO\ Al_2O_3 5\ SiO_2 + 2\ CaO\ SiO_2 + (x-1)\ SiO_2 \qquad (II)$$

One molecule of $15\ CaO\ Al_2O_3\ 5\ SiO_2$ and one molecule of $3\ CaO\ SiO_2$ are produced from each molecule of felspar. The extent of the decomposition of felspar depends on the purity of lime (Table II). The composition of the sludge being thus fairly known it is possible to find out the amount of tricalcium silicate and calcium aluminosilicate in the bricks. The values of crushing strength calculated from the formula are in close agreement with the experimentally observed values (Table II).

TABLE II

% Purity of lime	% decomposition of felspar	% lime as		Crushing strength lb. sq. in.	
		T.A.	A.S.		
90	90·8	1·26	6·31	5130	5047
70	70·0	0·974	4·87	3829	3896

Thanks of the authors are due to Dr. S. Husain Zaheer for his keen interest.

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December 11, 1950.

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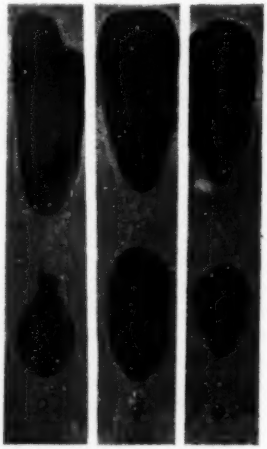
A MODIFIED AUTOBIOGRAPHIC TECHNIQUE FOR THE LOCATION OF "PHYSIOLOGICALLY ACTIVE" SPOTS ON PAPYROGRAMS

IN the course of our studies on the papyrographic separation and quantitation of antibiotics, vitamins and other growth factors, we were confronted with the problem of locating the 'physiologically active' spots on the papyrogram by the technique of bio-autography. Since rectangular dishes (45 × 25 × 2 cm.) usually employed for such tests[1,2] have not been readily available to us, we tried to use stainless steel 'Dishes' (40 cm. × 10 × 2 cm.) made to similar specifications. Our first trials with penicillin papyrograms developed according to the micro-method of Rockland and Dunn[3] as modified by Govindarajan and Sreenivasaya,[4] showed that it was difficult to locate the "active" spots. The technique was, therefore, modified by first layering the "dish" with a rectangular sheet of cellophane, with its two shorter ends over-reaching the lip of the dish. The nutrient agar medium inoculated with *S. aureus*, was then poured on to the dish and allowed to set. The papyrograms (1 cm. × 19·5 cm.) after developing were placed on the agar surface, gently pressed with a flattened glass rod to facilitate intimate contact of the paper and allowed to remain there for 30 minutes. During this period, the active principles from the 'spots' were expected to diffuse into the agar. The strips were then removed and the test "dishes" incubated at 37° C. for 18 hours.

With the help of the extra length of cellophane allowed to over-reach the lips of the dish, the agar layer can be easily lifted and held vertically for inspection. The "active" spots can be easily located as clear and transparent spots on the agar layer. Permanent records of such papyrogram preparations can be obtained by making contact prints on "Ilford reflex contact Document No. 50" (see Fig. 1).



1 2 3

Penicillium Notatum grown on the basal medium, supplemented with:—

1. Lac Washings. 2. Aqueous green gram extract. 3. Enzyme-free moldy bran extract.

Circles in the figure represent the areas spotted with the beer.

This method has been successfully applied for the characterisation and quantitation of the penicillins in the fermented beers and also, for the separation and identification of growth factors in the physiological fluids and tissue extracts.

Our grateful thanks are due to Prof. M. S. Thacker, our Director, for his kind interest.

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ANALYSIS OF SUGARS USING PAPER CHROMATOGRAPHY (*CAPILLARY ASCENT*)

During the course of our investigations on natural carbohydrates, we have had occasion to analyse a number of sugar mixtures and uronic acids, adopting Williams and Kirby's technique of ascending paper chromatography.[1] However, filter-paper strips (10 cm. × 36 cm.), perpendicularly hung from a frame, were used instead of the filter-paper cylinders which sometimes shrivel or even collapse. Irrigation with the solvent was allowed to proceed till the solvent front reached a height of about 28 cm., which usually took 14 to 18 hours depending on the nature of the solvent. The development of the spots was done by spraying with aniline hydrogen phthalate which was found to be much better than ammoniacal silver nitrate.[2] The use of alkaline potassium permanganate as a developer[3] was not satisfactory. The R_F values obtained differed in many cases from those calculable from the graph recorded by Wolfson, Cohn and Devaney[4] (actual values not given), but were in general agreement with the figures obtained by Partridge according to the solvent-descending method.[5]

TABLE

(R_F *Values obtained at* 20° C.)

	With water-saturated phenol		With water-saturated collidine	
	Partridge's values	Our values	Partridge's values	Our values
d-Glucose	0·39	0·38	0·39	0·39
d-Galactose	0·44	0·43	0·34	0·35
d-Mannose	0·45	0·43	0·46	0·45
d-Xylose	0·44	0·44	0·50	0·50
d-Arabinose	0·54	0·53	0·43	0·42
l-Rhamnose	0·59	0·60	0·59	0·58
Lactose	0·38	0·36	0·24	0·23
Maltose	0·36	0·36	0·32	0·30
d-Galacturonic acid	0·13	0·13	0·14	0·13
d-Glucuronic acid	0·12	0·11	0·16	0·15

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ELECTRODEPOSITION OF COPPER-TIN ALLOYS FROM FLUOBORATE BATH

Bright and adherent deposits of copper-tin alloys are obtained from the stannate-cyanide bath. The stannate-cyanide bath requires careful control of bath composition and anode current densities, when individual anodes are employed. The fluoborate bath employed by the present author has decided advantages over the one mentioned above. From the fluoborate bath containing both the metal fluoborates in solution, deposits similar to those obtainable from the stannate-cyanide bath, can be obtained. The preparation, operation and maintenance of the bath is simple. The bath is stable over long periods of operation in the presence of excess of free fluoboric acid. The accompanying table indicates the variation in composition with changes in current density and metal content of the bath:

Sn 31·18 g./L in bath — Anodic current density on Cu = 5·75 amp./sq. ft. Interanode distance 2" Room temp. 23°C. Anode cathode distance 3."

Copper content of bath	Anodic current density : Tin (amp./sq. ft.)	Metal content of the deposit (%)	
		Cu	Sn
3·98 g./L	5·75	21·4	71·6
	8·60	10·0	90·0
	11·50	9·5	90·5
7·95 g./L	5·75	50·0	50·0
	8·60	40·0	60·0
	11·50	31·0	69·0
15·90 g./L	5·75	82·7	17·3
	8·60	73·2	26·8
	11·50	56·2	43·8

The deposits obtained from the bath are fine, adherent and easily polished. The throwing power of the bath is satisfactory. From the table it will be seen that satisfactory deposits of any composition between 17·3% Sn — 82% Cu and 90% Sn — 9·5% Cu can be readily obtained. Deposits obtained beyond the range of c.d. mentioned are coarse and non-adherent. No appreciable change in composition of the deposit from that obtained at room temperature has been observed when the bath is operated at temperatures up to 60° C. Mild agitation has no influence on the composition of the deposit.

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DICHOCROCIS PUNCTIFERALIS GUENEE (CASTOR POD BORER) ON *ANDROPOGON SORGHUM* BROT IN MYSORE

Dichocrocis punctiferalis Guenee has been chiefly a castor pest, its caterpillars boring into castor pods and occasionally stems and constructing a slight webbing with frass particles on the shoots and seed capsules in a bunch.

Lefroy (1907, 1909) stated its food plants to be castor, sunflower head; cacao pods (in Ceylon); and "kaikar" fruits of *Garuga pinnata*.

Fletcher (1914) listed the host range as "Castor stem and pods, turmeric stem, ginger stem and rhizome, guava fruits". He further stated: "Outside Southern India, it has been reported as attacking mango flowers, cholam heads, peaches, cacao pods, cardamom capsules, etc."

Mohan Singh (1941) recorded it on hollyhock.

In Mysore we have noted this insect to infect tamarind fruits, mango flowers, pomegranate fruits, and also bore into cardamom stems in nature.

Recently in the course of our work on sorghum webbing caterpillars, *Dichocrocis punctiferalis* Guenee was found on the earheads of *Andropogon sorghum* Brot, in the laboratory compound of this Department, damaging the grains in the same way as the sorghum (Jawar) webbing caterpillar—*Stenochroia elongella* Hampson, common in Mysore. The caterpillars on the earheads were very well developed and seemed to prefer this host, in that the earheads were reduced into a powdered mass of grains and frass. The extent of damage can be made out from Figs. A and B.

B A

A. Infected *Sorghum* earhead.

B. Infected *Sorghum* earhead split open to show nature of damage. (Much reduced).

While continuing its study, we have been able to rear them also on stored grains of sorghum and also on rice bran. But these two food media were not equally well preferred.

Though we have noted this pest for the first time on sorghum it has not been taken on this crop in the fields. But it is interesting to note its wide host range—oilseeds, fleshy stems and fruits, flowers and dried cereal grains.

Sorghum is grown extensively in Mysore and is a staple food crop. It is usually subjected to the ravages of the webbing caterpillar, *Stenochroia elongella* Hampson, a major pest on the hardened grains in the earheads, in Mysore District. Castor is also a major oil seed crop in Mysore. Though the latter is grown as a seasonal crop in the fields, perennial castor plants exist in the backyards of village houses. The season of the two field crops—sorghum and castor, differs; the former is sown in March–April and harvested in August–September and the latter comes to bear pods later. The absence of the castor pod borer on sorghum in the field, may be due to the seasonal variations of the two crops. But there is every possibility of the pest extending from the perennial castor plants grown in village backyards, to sorghum earheads in the field as infected pods can be found throughout the year. It is also possible that this pest may invade the stored grains from field infections.

With its extensive host range and varying feeding habits, this insect must be viewed as a potential economic pest of cereal food crops. The damage would be much more serious when it breaks out along with the usual webbing caterpillar—*Stenochroia elongella* Hampson.

As a preventive measure against the spread of this pest, perennial castor plants in village backyards must be examined more often and infected pods destroyed by burning.

Detailed biology and bionomics of this pest are being studied.

We are grateful to Mr. B. Krishnamurthy, Government Entomologist, for help and constructive criticism.

Entomological Lab., M. PUTTARUDRIAH.
Dept. of Agric., G. P. CHANNABASAVANNA.
Bangalore,
January 15, 1951.

1. Fletcher, T. B., *Some South Indian Insects*, 1914 (Government Press, Madras), 433. 2. Lefroy, H. M., *Mem. Dept. Agri. Ind. Ent. Ser.*, 1907, **1** (2), 211. 3. —, *Indian Insect Life*, 1909 (Thacker Spink & Co., Calcutta), 517. 4. Mohan Singh, *Ind. Jour. Ent.*, 1941, **3** (1), 141.

POTATO PYROPHOSPHATASES

A LABILE alkaline pyrophosphatase, activated by Mg^{++} ions, was first demonstrated in erythrocytes,[1] and it was suggested[2,3] that this enzyme for its activity requires SH– and NH_2 groups. Similar enzyme was found in many animal tissues excepting bone.[4] A search was made to find whether such an enzyme is distributed in vegetable kingdom also. Successful results were obtained with potato.

There are only few reports on vegetable pyrophosphatases,[5,6,7] but in all these cases the enzymes had an activity optimum in acid pH. Potato is found to contain, besides several enzymes, a phosphomonoesterase,[5] a pyrophosphatase,[5] and an apyrase,[8] and here also all these three enzymes have an acid optimum pH. So far the alkaline pyrophosphatase in potato or in vegetable tissues was not investigated.

EXPERIMENTAL.—Skinned potato was cut into chips and crushed in a mortar, and ground well with twice its weight of cold double-distilled water. The extract was centrifuged, and with the clear supernatant the enzyme activity was determined at different pH values with and without added magnesium ions.

TABLE I

pH	Without added magnesium γ P liberated	With magnesium γ P liberated
2·62	nil	nil
3·20	8	..
3·62	26	..
3·88	39	..
4·13	52	45
4·53	65	..
4·66	68	..
4·93	72	57
5·32	66	..
6·12	52	16
6·75	35	31
6·99	26	..
7·25	20	..
7·42	14	46
7·66	11	..
7·90	9	..
8·18	4	..
8·55	6	78
8·16	3	81
9·64	nil	77

A mixture of 3 ml. of veronal-acetate buffer (M/35), 1 ml. $MgCl_2$ (M/10) or water, 0·5 ml. of $Na_4P_2O_7$ (M/100) was brought to 38° C., and 0·5 ml. of the enzyme solution was added, and incubated for exactly 15 minutes at 38° C. The enzyme activity was stopped with 2·5 ml. of 10% trichloracetic acid, filtered, and the *ortho*-phosphate determined in the filtrate. The results are given in Table I.

From the table it could be seen that the alkaline pyrophosphatase is inactive in the absence of magnesium, but exerts its maximum activity between pH 8·55 to 9·64 in the presence of 0·01 to 0·1 M. magnesium. With 0·001 M. or below of magnesium the activity is nil.

The enzymes can be purified by fractionation with amm. sulphate. The protein precipitated at 0·3 saturation showing negligible activity was discarded. The supernatant was brought to 0·6 saturation and the precipitated protein dissolved in water when a clear solution was obtained. This fraction contained most of the enzyme systems of the crude extract.

Studies on this purified preparation revealed that the acid enzyme has a broad activity optimum ranging from pH 4·33 to 6·75. It is therefore concluded that the crude extract contains some factors which inhibit the activity between pH 6·12–6·75. These factors seem to be absent or present only in small amounts in some batches of potatoes where the broad optimum was obtained. Most of the alkaline enzyme is present in the purified preparation, but the activity at pH 3·62 was very much reduced. Attempts at further purification by acetone precipitation resulted in loss of most of the alkaline enzyme, though the acid enzyme is not affected.

The alkaline enzyme is very unstable, and this spontaneous inactivation is more pronounced in acid medium (pH 5). Calcium acts as a competitive inhibitor producing more than 80% inhibition when $\ddot{Ca}/\ddot{Mg}$ is 0·1 $\ddot{Cu}$, $\ddot{F}$, $\ddot{Zn}$, HCHO, produce marked inhibitions at low concentrations. The Cü inhibition is reversible with cysteine, indicating thereby that thiol groups are essential for the enzyme activity. Formaldehyde inhibition suggests that amino groups also are essential. Thus the potato alkaline pyrophosphatase is very much similar to the erythrocyte and other animal tissue alkaline pyrophosphatases.

Comparing HCHO and Cu inhibitions of the alk. enzyme of the crude and the purified extracts it was found that the crude preparation suffered greater inhibition with HCHO, and very slight inhibition with Cu. There seem to be some factors in the crude extract which

form complexes with Cu and thus make the inhibitor ineffective.

Dept. of Chemistry, B. NAGANNA.
Madras Veterinary College,
Vepery, Madras 7,
January, 1951.

1. Naganna, B. and Menon, V. K. N., *Curr. Sci.*, 1947, **16**, 226. 2. —, *J. B. C.*, 1948, **174**, 501. 3. Naganna, B., *Ibid.*, 1950, **183**, 693. 4. —, Paper communicated to *Curr. Sci.* 5. Pfankuch, E., *J. Physical Chem.*, 1936. **241**, 34. 6. Giri, K. V., *Ibid.*, 1937, **245**, 185. 7. Jean Courtios, *Enzymologia*, 1937, **1**, 377. 8. Krishnan, P. S., *Arch. Biochem.*, 1949, **20**, 261.

AIR LAYERING IN LITCHI WITHOUT SOIL OR WATER

LITCHI is commonly propagated in India by air layering; but extensive watering is essential to get the desired grafts. Besides, many of the layers heal over and fail to produce roots, simply because they could not be watered so frequently as they ought to be.

Recently, it has been reported from Florida that ornamental plants have been air-layered with the help of sphagnum moss and air wrap (a special plastic material which allows exchange of respiratory gases but no loss of moisture) without watering the layers at all. This method was therefore tested for Litchi.

Shoots of all important varieties of Litchi growing at this Station were air-layered (in July 1950) when the weather was quite wet. Vigorous terminal branches, 18" to 24" in length, preferably with a fork near the top were selected. A ring of bark about one inch in diameter was removed and well scraped to make sure that there was no cambium left. Rootone (a well-known commercial product) was applied to the upper edge of the ring which was covered with thick damp sphagnum moss. Air wrap was then placed around moss and wrapped in such a manner that it was relatively air tight. Holding in this position each end was tied with rubber band. Watering was completely withheld.

After one and a half months, roots developed on the layers and were visible through the air wrap. They were left there for another fortnight when roots of good length had formed on each one of them. They were then detached from the mother plant and potted.

Govt. Fruit Res. Station, L. B. SINGH.
Saharanpur, U.P.,
January 19, 1951.

THE CHROMOSOME NUMBERS IN THE FAMILY ANONACEAE

A NOTE was published by one of the authors (R.D.A.), jointly with Prof. J. J. Asana,[1] on the chromosome numbers in the family Anonaceæ. Since then, Bowden[2,3] figured the chromosome complements of some more species in the family.

The family Anonaceæ has an important phylogenetic position and it is very desirable that the number and the morphology of the chromosomes be described in more genera of this family.

The present authors worked on *Cananga odorata*, H.f. & Th. and *Saccopetalum tomentosum*, H.f. & Th. The former is available in the gardens and the latter grows wild in Bombay and its environs. The haploid and diploid chromosome numbers found in *Cananga odorata*, H.f. & Th. were eight and sixteen respectively. These numbers agree with the counts given by Bowden.[2,3]

In *Saccopetalum tomentosum*, H.f. & Th. the haploid number, as observed at diakinesis, I and II metaphase in the pollen mother cell

FIG. 1. Saccopetalum tomentosum. First metaphase plate. (× 2775).

nuclei and I metaphase of the megasporocyte nuclei, was found to be nine (Fig. 1). The haploid chromosome number for this genus has been recorded here for the first time.

M. M. Arts College and R. D. ADATIA.
N. M. Institute of Science, D. B. CHOKSHI.
Andheri (Bombay),
January 2, 1951.

1. Asana, J. J. and Adatia, R. D., *Curr. Sci.*, 1945, **14**, 74-75. 2. Bowden, W. M., *Amer. Journ. Bot.*, 1945, **32**, 81-92. 3. —, *Ibid.*, 1948, **35**, 377-81.

PROPAGATING JACKFRUIT *ARTOCARPUS INTEGRIFOLIA* BY AIR-LAYERING WITH HORMONES

AIR-LAYERING of jackfruit shoots was tried by the author with a view to overcome the serious disadvantages resulting from seed propagation. A large number of two-year old shoots having diameter from 1·4 cm. to 1·8 cm. were air-layered simultaneously by using the following rooting media: (i) Clay and sand; (ii) Seradix A (a commercial product) in the concentrations

of 0·05 per cent. and 0·025 per cent. respectively; (iii) α-naphthalene acetic acid in the concentrations of 0·05 per cent. and 0·025 per cent. respectively.

The results are summarised below:

Table showing the number of successful air layers in jackfruit by using hormones

Treatment	No. of shoots treated	No. of air layers rooted	No. of air layers died on trans-planting	No. of successful air layers
Control (sand and clay)	50	24	14	10
Seradix A. (0·05%)	50	38	18	20
Alphanaphthalene acetic acid (0·05%)	50	30	6	24
Seradix A. (0·025%)	50	36	0	36
Alphanaphthalene acetic acid (0·025%)	50	36	8	28

It may be mentioned that rooting due to application of Seradix A and α-naphthalene acetic acid in concentrations of 0·025 per cent. was profuse as shown in Fig. 1. This profuse

FIG. 1

rooting is possibly responsible for greater survival of air layers in this case, compared with control ones, since their rooting was relatively weak.

These air layers are ready for transplanting in 3 months and reach such length and thickness which a seed-propagated plant attains in 2 to 3 years.

Govt. Fruit Res. Station, Saharanpur, U.P., *January* 3, 1951. L. B. SINGH.

A SYNCHYTRIUM DISEASE OF *UDID* BEANS

LEAVES of *udid* beans grown in a garden near Poona were found severely parasitized by a species of *Synchytrium*. Only the lower leaves, being well protected against direct sunlight, were infected and, due to improper leaf-expansion were smaller in size, showing galls on both surfaces. There was no thickening of the leaf tissue in the infected region. The formation of prosorus and sporangial stages has not been observed.

Patel, *et al.*[1] described a leaf-spot disease of *Phaseolus mungo* from Jalgaon, Bombay, caused by a fungus which was identified as *Synchytrium phaseoli* Patel, Kulkarni & Dhande. An examination of authentic material secured through the kindness of Dr. M. K. Patel has revealed that the fungus may not be a *Synchytrium*, since the resting spores are produced in the intercellular spaces of the leaf-mesophyll similar to the oospores of the downy mildews. The fungus under study, represents an undescribed species of *Synchytrium* and its name is proposed in honour of Prof. S. L. Ajrekar. Type is deposited in *Herb. Crypt. Ind. Orient.*, Delhi.

Synchytrium ajrekari Payak & Thirumalachar sp. nov. (Fig. 1).

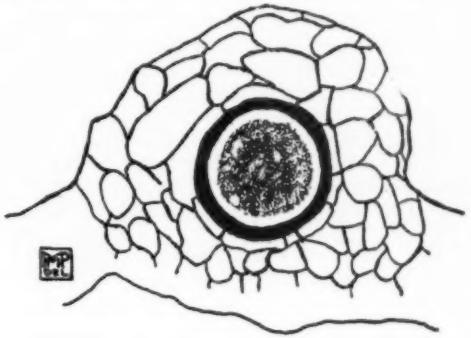


FIG. 1. Synchytrium Ajrekari T. S. of Leaf passing Through a gall showing Hypnospore × 115.

Galls on the leaves amphigenous, simple, rarely coalescing and compound, appearing as

tiny tubercles. Hypnospores spherical, filling the host cells, golden-brown, 114-266 μ in diameter, surrounded by a hemispherical mound of thin-walled tissue above, thick-walled, wall 8-11·5 μ thick.

Hab. on the lower leaves of *Phaseolus mungo* L. Leg. M. M. Payak, Poona, 12th October 1950.

Gallæ in foliis amphigenæ simplices, raro coalescentes atque compositæ, apparantes ut minuti tuberculi. Hypnosporæ sphæricae, plantæ hospitis cellulas implentes, aureo-brunneæ, 114-266 μ diam., circumdatæ acervo hemisphærico texturæ tenuiter supra parietatæ, parietibus crassis præditæ, muro vel pariete 8-11·5 μ crasso.

Hab. in foliis inferioribus *Phaseoli mungo* L. lectus a M. M. Payak, in loco Poona, die 12 Octobris 1950.

The writer is grateful to Dr. M. K. Patel for help in examining the specimens, and to Rev. Father H. Santapau, S.J., Head, Dept. of Biology, St. Xavier's College, Bombay, for the Latin diagnosis.

Botany Lab. of M.A.C.S., M. M. PAYAK.
Law College Building,
Poona,
January 25, 1951.

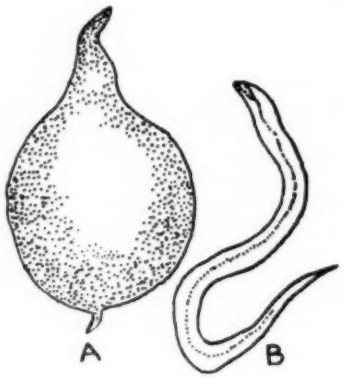
1. Patel, M. K., Kulkarni, Y. S., and Dhande, G. W., *Curr. Sci.*, 1949. **18**, 171.

ROOT-KNOT NEMATODE ON POTATO TUBERS IN SIMLA

POTATO TUBERS showing scab-like warts from the Potato Breeding Sub-Station, Simla, on microscopic examination, revealed that the warty galls were incited by the root-knot nematode *Heterodera marioni* (Cornu) Goodey. The disease was reported to be quite severe on the tubers in restricted areas in the Sub-Station.

The nematode infestation on the tuber appears first, as tiny tubercles but heavy and localised infestation, stimulates excessive cell division of the host, leading to gall formation. When an infested tuber is cut across, the female worms of the size of a pin-head may be observed as glistening white bodies embedded within the potato tissue. The adult female worms (Fig. 1) are pyriform, often showing the egg case, which are light-brown to black *en masse*. The male worms (Fig. 2) are filiform and in general outline does not differ from the larval stages.

The root-knot nematode has a wide range of hosts and can build up to epidemic proportions.



A. Femals worm × about 60.
B. Male worm × about 80.

Grateful thanks are due to Dr. Pushkarnath, Botanist, Potato Breeding Sub-Station, Simla, for the supplying of diseased material and to Dr. S. Ramanujam, Director, Central Potato Research Institute, for valuable suggestions.

M. J. THIRUMALACHAR.
Central Potato Research Institute,
Patna,
December 26, 1950.

DISEASES OF SPINACH

PADWICK AND KHAN (1945)[1] have reported the leaf-spot of spinach (*Spinacia oleracea* L.), caused by *Heterosporium variable* (*H. variabile*) from Srinagar in the Kashmir State.

S. No.	NAME OF THE DISEASE	CAUSAL ORGANISMS
1.	Damping-off	(i) *Pythium de Baryanum.*
		(ii) *Fusarium spinaciæ.*
		(iii) *Rhizoctonia solani.*
2.	Leaf-spot	*Cercospora spinaciæ.*
3.	Alternaria-blight	*Alternaria spinaciæ.*
4.	Anthacnose	*Colletotrichum spinaciæ* Ell. and Halst.
5.	Root-rot	(i) *Fusarium solani.*
		(ii) *Rhizoctonia solani.*
6.	Black mould	*Cladosporium macrocarpum.*

The detailed investigation of the important diseases of spinach was undertaken during 1947-49 at Kanpur.*

A record of the diseases with their causal organisms is given above.

These are the first records from India.

Full details of this work will be published shortly.

Botany Section, BABU SINGH.
Agricultural College, VIPIN C. GUPTA.
Kanpur,
February 20, 1951.

1. Padwick G. Watts and Khan, M. A., *Notes on Indian Fungi*: III. *Mycological Papers* No. **12**, Page 15, 61. 2. Saccardo, P. A., *Sylloge Fungorum*, **10**, 13.

* Thesis submitted in partial fulfilment of the requirement for the M.Sc., (Agriculture) degree of the Agra University.

CHROMOSOME NUMBERS IN SOME FLOWERING PLANTS

EXCEPT *Cichorium intybus* L., whose doubtful chromosome number has been confirmed here, all other numbers are new as far as known to the author.

Apocynaceæ	
Plumeria alba ..	$n = 18$ } $2n = 36$ }
Plumeria rubra ..	$n = 18$
Plumeria acutifolia ..	$n = 18$
Carissa carandus Linn. ..	$n = 11$
Carissa spinarum Linn. ..	$n = 11$
Meliaceæ	
Cedrela toona Roxb. ..	$n = 28$
Sapotaceæ	
Bassia latifolia Roxb. ..	$n = 12$
Verbenaceæ	
Lantana camara Linn. ..	$n = 22$
Acanthaceæ	
Sanchesia nobilis ..	$n = 68$
Compositæ	
Inula indica Linn. ..	$n = 9$
Pulicaria crispa Schutz-Bip. ..	$n = 10$
Eclipta erecta Linn. ..	$n = 11$
Cichorium intybus Linn. ..	$n = 9$
Convolvulaceæ	
Convolvulus pluricaulis Chois. ..	$n = 10$

I thank Dr. G. N. Pathak for verifying these chromosome numbers.

Govt. Agri. College, BHUPENDRA SINGH.
Kanpur,
December 19, 1950.

1. Makowetsky (1929) as quoted by Darlington and Janaki Ammal (1945), *Chromosome Atlas of Cultivated Plants.*

PROBABLE BUD SPORTS IN CITRUS

CONSIDERING the importance of bud-sports in citrus,[1] a planned search for them was carried out at this Research Station. So far, the following two important variants in citrus have been noted.

1. *Variant in* Citrus Medica *Linn.* (*Citron*). *Turanj**.—This is a very acidic species of citrus, mostly used for medicinal purposes. Normally, the fruit of this variety is highly warty, very thick skinned and hard to press. The fruit-shape is obovoid with a knob at the terminal end. Locules in the inner chamber are small and broad with dryish vesicles. On an average, the pH of the juice is found to be 2·5 as tested by the pH test papers.

A variant fruit was observed on a twig of the same tree, which was entirely different from the normal, described above. In this case the fruit was smooth skinned and less hard to press. Shape of the fruit was more or less ovoid. In T.S., the skin was about half the thickness of the normal and the locules in the inner chamber were longer and narrower with more juicy vesicles than the normal. The pH was 2·8 showing it to be relatively less acidic. Thus, this is definitely an improvement over the normal type.

2. *Variant in* Citrus sinensis *Linn., Malta variety, Whitaker.*—Normally, the shape of the fruits of this variety is globose with smooth to finely pitted outer rind. Base of the fruit is evenly rounded, apex being also rounded with slight depression, having a stylar scar. On an average, the pH of the juice is 4·3 and the fruits are quite seedy.

Two fruits, with entirely different shape, were observed on a limb of the same tree. The shape of these fruits was somewhat pyriform with more or less pitted surface. The base of the fruit was short necked. The pH of the juice in this case was 3·6, thus slightly more acidic than the normal. Moreover, there were relatively less seeds.

The twigs of these two major variants along with other minor variants have been tagged for further observations. A detailed paper will be published in due course.

Fruit Research Station, R. N. SINGH.
Saharanpur, U.P.,
February 12, 1951.

* It is popularly known as Turanj.

1. Webber, H. J., and Batchelor, L. D., *The Citrus Industry*, 1948, **1**, 915-52.

THREE BACTERIAL DISEASES OF PLANTS

WHILE carrying out a plant disease survey in Bombay State, the writers came across three bacterial diseases hitherto unreported from India. Of these the one on *Begonia* sp. resembles that described by Takimoto[1] on a species of the same genus by *Xanthomonas begoniæ* (Takimoto) Dowson in all respects.

The symptoms of diseases produced on *Stizolobium deeringianum* Bort. by *Pseudomonas stizolobii* (Wolf) Bergey, *et al.*, and on *Piper betle* L. by *Pseudomonas betlis* (Ragunathan) Bergey, *et al.* are also indistinguishable but the causal organisms are, however, not the same, which has necessitated the establishment of two new species to accommodate these organisms and are described below:

(1) *Xanthomonas begoniæ* (Takimoto) Dowson on several varieties of *Begonia* sp. at Poona.

(2) *Xanthomonas stizolobiicola* sp. nov.—Slender rods; mostly single; motile; capsulated; no spore or involution forms; gram negative; not acid fast; ærobe; gelatin liquefied; starch and casein hydrolysed; ammonia and hydrogen sulphide produced; creamy to pinard yellow; glistening, flat colonies with entire margins measuring 8 mm. in 4 days on nutrient and potato dextrose agars; good growth in nutrient broth; acid but no gas in dextrose, lactose and sucrose, but no growth in salicin, when grown in peptone free medium; indol not produced; M.R. and V.P. tests negative; no growth in synthetic asparagine medium; Lœffler's blood serum liquefied in 10 days; nitrates not reduced; NaCl tolerant upto 3%; lipolytic; optimum temperature for growth between 28-30° C.

Pathogenic on leaves, petioles, stem and leaf edges of *S. deeringianum*. Collected at Bulsar (Surat).

(3) *Xanthomonas betlicola* sp. nov.—Slender rods; single or in pairs; motile; capsulated; no spore or involution forms; gram negative; not acid fast; ærobe; gelatin liquefied; starch and casein hydrolysed; litmus reduced; ammonia and hydrogen sulphide produced; on potato dextrose agar, the colonies are baryta yellow with lobate margins and striations at periphery, measuring 11 mm. after 7 days; good, cloudy, yellow growth in nutrient broth; growth on potato cylinders, copious; acid but no gas in dextrose, lactose and sucrose, but no growth in salicin, when grown in peptone free medium; nitrates not reduced; indol not produced; M.R. and V.P. tests negative; no growth in synthetic asparagine medium; NaCl tolerant upto 3%; Lœffler's blood serum liquefied; lipolytic; optimum temperature for growth between 25-28° C.

Pathogenic on leaves, stems and petioles of *P. betle*. Quite common in betlevine gardens.

Detailed account will be published elsewhere.

Plant Path. Laboratory, College of Agriculture, Poona,
M. K. PATEL.
Y. S. KULKARNI.
G. W. DHANDE.

January 8, 1951.

1. Bergey's *Manual of Determinative Bacteriology*. 6th ed. Bailliere, Tindall and Cox, London, 1948.

VISITING SCIENTISTS TO S.E. ASIA

THE UNESCO Office at Delhi has been receiving news of the journey of a number of scientists across the countries of this region on some mission to another part of the world. It has been suggested that they may be induced to stop over for a few days at some places where hospitality can be arranged by interested institutions. Very frequently news of their trip comes at a very short notice and arrangements cannot be completed for eventual visit. Scientific institutions in this region may therefore kindly communicate their interest in the various fields of study and the type of engagements they would like for the visiting scientists so that tentative lists of institutions in different branches of study may be made ready for future reference. The Office may be also informed if some contribution to their travel expense within the country can also be made available. Many of the recently expected arrivals are American Fulbright professors mostly working in the Philippines and a team of the geneticists on way to a Symposium on Genetics and Evolution in Brisbane in May 1951, organized jointly by the Australian and New Zealand Associations for the Advancement of Science.

REVIEWS

Vector and Tensor Analysis. By Harry Lass. (McGraw-Hill Book Co.), 1950. Pp. xi + 347. Price $4·50.

This book is the first to be published in the International Series in Pure and Applied Mathematics designed to meet the needs of students at Honours standard.

The books written primarily for students (including even advanced ones) are generally expected to cover a particular branch of a subject thoroughly. But the author of the book under review has attempted to indicate the use of vector and tensor analysis in geometry, mechanics, electricity, hydrodynamics, elasticity and relativity. He has even included a chapter on the theory of integration covering such topics as point set theory, definition of a Jordan curve, Riemann integral and surface and volume integrals. This should not give the impression that these topics have been covered thoroughly. As a matter of fact, the chapter on integration (38 pages) looks more like a brief resumé. Indeed the whole book may give such an impression. The book is, however, quite useful as additional reading. It shows the student the use of vector and tensor methods in various branches of mathematics and prepares him for advanced reading in theoretical physics. There are very few books serving this need. Prof. Lass's book covers the need admirably. This book can be warmly recommended to all our libraries and students in physics and mathematics.

N. S. NAGENDRA NATH.

New Atoms (Progress and Some Memories). By Otto Hahn. (Elsevier Publishing Co., Inc., New York; London Agents: Cleaver-Hume Press, Ltd., 42-A, Sout Audley Street, London W 1), 1950. Pp. 184. Price 12 *sh.* 6 *d.*

This handy little volume unifies several of Prof. Hahn's publications on radioactivity and allied topics into a single work. The book is divided into four chapters. The first chapter gives the lecture delivered by Prof. Hahn while receiving the Nobel Prize. In this lecture he traces briefly the history of the progress of nuclear physics, starting from the discovery of natural transmutation of uranium and ending with the discovery of its artificial fission. The crucial experiments that had to be carried out by Hahn and Strassmann in order to establish unequivocally the occurrence of the fission of the uranium nucleus have been described in some detail.

Chapter 2 deals with the various aspects of the discovery of chain reaction in uranium. Detailed reference has been made to the following topics: Difference in behaviour of the U(235) and the U(238) nuclei, the uranium pile, plutonium, potential uses of atomic energy, the atom bomb and the production and uses of radioactive elements. The new synthetic chemical elements which have come into prominence in recent years are dealt with in Chapter 3. They are ten in number and fall into two groups. The elements, 43 (Technecium), 61 (Promethium), 85 (Astatine) and 87 (Francium) from the first group. They fill up of the gap in the existing Periodic Table. The second group comprises the so-called transuranic elements, 93 (Neptunium), 94 (Plutonium), 95 (Americium), 96 (Curium), 97 (Berkelium) and 98 (Californium) which fall in the region beyond the Periodic Table. A short account of the discovery of these new elements, methods of production in weighable quantities and their important properties has been given in this chapter.

In the last chapter which is less scientific in character, the author describes some personal reminiscences from the history of natural radioactivity in which he played a prominent role. His contributions to the knowledge of natural radioactive elements and their disintegration products during the first fifteen years his scientific career have been narrated in a historical sequence. Reference has also been made to some of the important anecdotes connected with the days he spent in Ramsay's Laboratory in London and in Rutherford's Institute in Montreal.

The book under review contains a short, intelligent and masterly account of the modern problems of nuclear physics written by one who is considered as one of the world's outstanding authorities on radioactivity and nuclear research. It is very instructive to the reader to learn at first hand the details of the history of some of the discoveries in this field of research. The book is to be warmly recommended to every atomic scientist.

R. S. K.

Elsevier's Encyclopaedia of Organic Chemistry. Edited by F. Radt. Series III. Carboisocyclic condensed compounds. Vol. 12B., Naphthalene. A. Compounds containing one naphthalene nucleus. Oxo-compounds (except Quinones). (Elsevier Publishing Co., Inc., New York), 1950. Pp. 2189-2716. Price £ 14.

In reviewing the third part of Vol. 12B containing pages 1053-2187, it was stated that of the 18 Volumes (*plus* Vol. XIX: Subject Index and Vol. XX: Formula Index) which are to comprise *Elsevier's Encyclopædia*, Vols. XIV and XIII, Vol. XIIA and Vol. XIIB, Parts 1 and 2, had so far appeared. The book under review is the fourth part of Vol. 12B and deals with aldehydes and ketones (but not quinones) of the naphthalene series. The literature has been consulted until the end of 1944, and for the structure of compounds the literature extends to the beginning of 1950. Compounds containing one or more carbonyl groups in the nucleus or the side chain are described, as well as their derivatives containing alkyl, amino, halogen, hydroxy and nitro substituents. For each carbonyl compound, the usual derivatives, such as anils, oximes, hydrazones and semicarbazones, are mentioned. Hydronaphthalenes containing carbonyl groups and their derivatives are then described. The ketohydronaphthalenes are important intermediates for synthesis, for example in the steroid field, and the comprehensive data now presented on the ketohydronaphthalenes are very valuable.

The remarks made in the earlier review on the thoroughness of the treatment in Elsevier, the logical arrangement and the indices that enable a compound to be readily located, the usefulness of the summaries of subject-matter under major heads, the exhaustive data on chemical, physical and physiological properties, and the excellence of the printing—all these apply equally to the present volume. The subject index, however, can be enlarged with advantage to include more fully the derivatives of the listed compounds that are described or mentioned. Thus methylbenzanthrones and halogenobenzanthrones obtained by the cyclization of benzoylnaphthalenes are mentioned in the text, but not in the index; these have appeared in the volume dealing with the benzanthrones, but as cross references between volumes, and considering also the interval before completion of the Elsevier series, a very detailed index for each volume will be of great value.

A few omissions have been noticed. The cyclization of various derivatives of 1-benzoylnaphthalene to the corresponding benzanthrones has been mentioned, but not the cyclization of the parent ketone to benzanthrone; this important dyestuff intermediate is now made from anthraquinone, but the possibility of manufacture from 1-benzoylnaphthalene is not ruled out. Attention was drawn in the earlier review to the disadvantages of isolating patent literature in separate volumes; to cite one instance, 1-benzoylnaphthalene is considered in detail in the present volume, but patent references (e.g., B.P. 591,610; U.S.P. 2,487,777) to the separation of the compound from the 2-isomer, which is formed simultaneously to the extent of about 20% in the Friedel-Crafts relation between benzoyl chloride and naphthalene, are not mentioned. Apparently for the same reason that it is the subject of patents, no reference is made to the suggested use of 4-benzoyl-1-naphthol and other 4-acyl-1-naphthols as azoic and azo dye coupling components. The Scholl cyclization of 1 : 4-dibenzoylnaphthalene to 3 : 4 : 9 : 10-dibenzpyrene-5 : 8-quinone is mentioned, but not the technically important cyclization of 1 : 5-dibenzoylnaphthalene to 3 : 4 : 8 : 9-dibenzpyrene-5 : 10-quinone (Indanthrene Golden Yellow GK). 1 : 5-Dibenzoylnaphthalene is prepared technically by the action of benzoyl chloride and aluminium chloride on naphthalene (D.R.P. 576, 253), but the only methods mentioned are from (*a*) naphthalene-1 : 5-dicarboxylic acid chloride and benzene, and (*b*) 1 : 5-dicyanonaphthalene and phenylmagnesium bromide.

K. V.

Natural and Synthetic High Polymers. By Kurt H. Meyer. A Text-Book and Reference Book for Chemists and Biologists. Vol. IV of the High Polymer Monograph Series. (Publishers: Inter Science Publishers Inc., New York), 1950. Pp. 891. Price $ 15·00.

This book is the revised and enlarged edition of Meyer's book on High Polymers, Vol. IV of the High Polymer series. The text has been almost re-written and has been enlarged by about 200 pages over the previous edition. With a brief introduction pertaining to definition and classification, molecular weight, morphological and thermodynamic approach to the study of high polymer chemistry, the author has divided the subject-matter into eleven well ordered selections. The first 92 pages deal with physical and physico-chemical investigation of polymers in solution and in solid state with X-rays, electron microscope, birefringence and polarized infra-red radiation, with appro-

priate theoretical background. Section 2 deals completely with inorganic polymers, chain, net and three-dimensional types. Results of X-ray studied have been critically reported. High polymeric hydro-carbons and their derivatives of the addition polymerization types form an important section of the book. For details, the reader can always go to original papers to which references are adequately given.

Condensation polymers form the next section wherein investigations on polymeric ethers, esters, sulphides, amides, phenoplasts, amino plasts, etc., have been reported. These are admittedly only reports; and as a reference source is fairly adequate. Cellulose and its derivatives have been adequately dealt with in the 5th section. Commercial applications of cellulose products, and mechanical properties of cellulose and its derivatives, as also their mechanical breakdown have been reported on, up-to-date. Among natural high polymers, the largest group is, certainly, the proteins and the author's report on proteins covers over 150 pages. Beginning with an introduction to the constitution of proteins, he discusses different types of proteins, such as fibrillar, globular, conjugated proteins, proteins of marked biological activities and with enzymatic properties, under different sub-sections. Viruses and virus proteins also find a brief mention. Ultra-centrifugal, flow birefringence and X-ray methods have contributed greatly towards the understanding of the shapes and other molecular dimensions of these particles. The author's view, based on the presentation of experimental evidence, that virus particles behave truly as organisms will find wide acceptance. The chapter on proteins ends with the behaviour of proteins in solution.

Properties of high polymers in solution is a very useful chapter as an introduction to that subject and deals with the elasticity and viscosity of such solutions. Readers would do well to supplement their knowledge of this subject by reference to the recent book, Vol. II of the High Polymer series by Mark and Tobolsky.

In the field of synthetic High Polymers, a stage perhaps has been reached, where no new plastic material of spectacular properties could be discovered. But from the point of view of fundamental investigation into the nature and behaviour of High Polymers, as research in this field advances, greater is our perplexity, and in the words of the author, "the number of problems in the solution of which biology and chemistry of high polymers must join forces is infinite; wherever there is life, there is structure, a structure built up from high polymeric molecules".

Perhaps a short chapter on the mechanical behaviour of high polymers would have been welcome, but the author has taken care to refer to mechanical behaviours wherever found necessary in the body of the book. The book is admirably written and is indispensable to any scientific library. To the polymer chemist and biologist, it should be a fine reference book and the reviewer has no hestitation in recommending the book to investigators in the high polymer field. The book is admirably got up without any noticeable blemish. On page 683, instead of "see fig. 4, page 79", read "see fig. 4, page 19". A couple of very minor typographic errors are noticed on pages 265 and 822. The book is well indexed.

M. S. MUTHANA.

Electrical Engineering Design Manual: By S. Parker Smith and M. G. Say. Second Edition. Revised. (Chapman & Hall, Ltd.), 1950. Price 16 *s.* net.

This book is written by two Professors with long experience in the teaching of electrical engineering design.

In Part I of this book, the subject-matter is arranged in such a way as to give the student of design a knowledge of the basic principles underlying the design, such as: the laws of electric and magnetic circuits, the theory of armature windings, the equivalent circuits of electrical machines and also the economic and other reasons that have led to the adoption of present-day methods. From this point of view the chapter on Specifications is very useful. Chapter III on Heating, Cooling and Ventilation, similarly, deals with the factors that enter into the calculation of heat-flow and temperature-rise in electrical machinery.

The book does not purport to set out completely the procedure for designing transformers, generators, motors and other machines. Its primary object is to show how important data may be obtained from the underlying physical principles rather than by empirical methods. Adequate use is made of worked examples to illustrate the methods. The references indicated at the end of the chapters are all standard books of electrical design.

Part II of the book discusses in brief the speed-time curves and the nature of industrial drives. The discussion is rather general, probably due to space-restrictions. References are wanting. Perhaps the authors' idea is that the teaching staff will amplify the material and

guide the interested student further in the subject.

As the authors have stated in the Preface, the material of the book is intended for students rather than for designers. It needs a teacher to clarify and amplify many of the finer points of electrical design. But it is evident that the authors have taken great pains to present their ideas clearly and cogently. Their impact on students of electrical design cannot fail to have beneficial results. We extend to this new book in the field of electrical design a very hearty welcome.

H. V. GOPALAKRISHNA.

Wave Motion and Sound. By R. W. B. Stephens and A. E. Bate. (Edwin Arnold & Co., London). Pp. 445 + vi. Price 45 *sh.* net.

In most of our Universities, sound has become a Cinderella subject. The reason obviously lies in the nature of the subject itself. To some teachers, it is nothing but a collection of mathematical exercises. To a few others much less mathematically inclined, the experimental aspects have a powerful appeal. It is only the gifted teacher who can present the proper perspective of the subject, emphasizing its vital connections with the other branches of physics and holding the proper balance between theory and practice.

It is therefore not an easy job to write a text-book on sound. Even in standard text-books, the modes of approach may be seen to be greatly different. It is therefore not surprising that in the book under review, the presentation is on a new basis. Emphasis is laid on the theory of vibrations and attention is drawn to the consequent links with light, heat and electricity.

The book contains sixteen chapters, of which seven deal essentially with wave motion. The other nine are devoted to the remaining aspects of the subject. The chapters on architectural acoustics, on electrical, mechanical and acoustical analogies and on ultrasonics are of special interest, since they present much up-to-date information.

There are thirty mathematical appendices running over 75 pages. These are intended to meet the special requirements of the honours students. While these appendices are of great value, the reviewer feels that they could have been included in the body of the book at the appropriate places. The student will then be able to appreciate their significance and connection with the text to a better extent.

The authors have given a set of 94 useful examples at the end of the book. These are carefully chosen to test how far the student has appreciated the fundamentals of the subject.

The book is sure to be appreciated by students and teachers of acoustics. S. R. R.

The Nature of the Universe. By Fred Hoyle. (Basil Blackwell, Oxford), 1950. Pp. 121. Price 5 *sh.* net.

This is an eminently readable book. Its purpose is to present to the lay reader the essentials of modern cosmology. The material was originally broadcast and the lectures then delivered are here published without any change.

There are five chapters. The first gives an account of the earth and its immediate neighbours. The origin of stellar energy is considered in the next chapter and a brief account is given of the nuclear processes that account for such large and continuous emissions of energy. The origin and evolution of the stars are then set forth. Detailed pictures are given of the birth and death of the sun and of the mehods for finding the ages of stars. Investigations show that our galaxy is still in its early youth (four thousand million years old) and is really a scene of intense and ceaseless activity. The earth itself is younger, but not very much younger, than the stars of our galaxy. Details relating to the origin of the earth and the other solar planets and the possibilities of life in other planets make interesting reading. The last chapter draws attention to the presence of vast numbers of other galaxies in the Universe similar to our own galaxy.

The picture of the new cosmology has been built together into a cogent whole by the aid of modern science. There are no doubt several lacunæ in the structure. The impact of philosophy on these concepts is still obscure. Whether the Universe as conceived by modern science will stand the test of time is an open question. But none can deny that the picture as it stands today is the outcome of a wonderful co-operative spirit and constitutes a tribute to the intelligence of man.

The book is sure to interest the layman and the specialist alike. S. R. R.

The Structure and Mechanical Properties of Metals. By Dr. Bruce Chalmers. (Chapman & Hall, London), 1951. Pp. 132 + ix. Price 18*s.* net.

This monograph, the second of a series published under the ægis of the Royal Aeronauti-

cal Society, by an authority in the field of Physical Metallurgy, will be read with interest and profit by all metallurgical engineers. Without resorting to advanced mathematical considerations, Dr. Chalmers has given a simple and comprehensive picture of the structure of metals and alloys and of the relationship between structure and ultimate mechanical properties. Dendritic and eutectic solidification, formation and structure of intermetallic compounds, slip on dislocation theory and fundamental concepts regarding mechanical properties are some of the topics dealt with in the monograph.

The treatment is throughout clear, brief and authoritative. The copious illustrations are very helpful and informative. The curves relating the tensile strength and other mechanical properties with grain size, extent of cold work, proportion of allowing elements, plastic strain, etc., appearing in the last chapter will be of particular interest to engineers. The lack of bibliographies is not so serious, because the text is highly condensed and gives the generally accepted views; besides, as stated by the author, this is not a reference book.

In spite of the excellence of the paper, printing and get-up, the price (18 *sh.*) of the monograph is rather prohibitive.

E. G. R.

Aerials for Centimetre Wavelengths (*Modern Radio Technique Series*). By D. W. Fry and F. K. Goward. (Cambridge University Press). Pp. 172 + x. Figs. 65. Price 18 *sh.*

With the vast developments in the microwave technique and the consequent application in the fields of Radar and Radio Communication, a great need has been felt for a book dealing with the subject of microwave aerials in a simple but comprehensive manner. The authors of *Aerials for Centimetre Wavelengths* seem to have this point in view, and they have really succeeded in the difficult task of giving a very lucid and comprehensive treatment of this subject without recourse to mathematics. The vast developments in microwave aerial technique at the Telecommunications Research Establishment, with which the authors were associated, are dealt with in detail in this book.

The text deals in the first chapter with the general requirements of centimetre aerials. The primary radiators such as dipoles and open ended waveguides and the secondary radiators such as reflectors, lens and horns are described very well in the fourth, fifth, sixth and seven chapters. The subject of scanning has received its due share of importance in the text. The several methods of scanning and their relative merits and suitability of application for any particular case are very well discussed. The close analogy between the centimetric work and optical theory is very well brought out in the chapter dealing with the dielectric and the metal plate type of lens.

The several references in the text and the bibliography in the end are very useful to those wishing to refer to the original papers. Printing and production are both excellent. The book can very well be recommended for the use of the research worker as well as the practical engineer in this field.

V. N. R.

First Year Calculus. By M. N. Bhat. (The Educational Publishing Co., Bombay 4), 1950. Pp. 190. Price Rs. 3.

This is a text-book for the first year course of the Poona University, covering also more than half of the Intermediate syllabuses of some other universities. Since it is intended for beginners, the treatment is mainly descriptive and elementary, though vigour has been introduced wherever necessary. The concepts of limit and differentiation have been very clearly presented in three chapters. The following two chapters are devoted to physical and geometrical applications, and the last two, for integration.

Every chapter contains a number of exercises and illustrative examples. The book could have been made more interesting to students above the average by the addition of some topics even outside the syllabus, like applications of differentiation of function of a function, angle of intersection of two curves, differentiation of higher orders and some advanced examples.

One outstanding defect is that the sign of the differential coefficient of inverse sine and cosine functions is left ambiguous.

On the whole it is a well-written book and it is sure to serve the purpose for which it is intended.

S. N. M.

Commercial Methods of Testing Milk and Milk Products. By J. Lyons and M. J. O'Shea. (Cork University Press, Ireland), 1950. Pp. 218; Illustrations 55; Price 15 *s.*

This book containing the elements of routine methods of quality control of milk and milk products has been prepared by the authors keeping in view chiefly the needs of the "dairy

students and persons engaged on the technical side of dairying", and makes no attempt to discuss the methods in detail or the principles underlying them, presumably to prevent the technician from being unduly confused.

A major part of the book is devoted to the determination of butterfat in milk and milk products and methods are presented and illustrated with examples for the rough calculations of yields of milk products from milk. Methods for the determination of total solids, solids not fat, and acidity in milk and milk products as also for the determination of water, salt and curd in butter and for the detection of adulterated milk have been described. A number of platform and routine tests have been grouped under 'tests for sanitary quality of milk', and under 'other useful tests in the dairy', and are intended to be useful in meeting a wide variety of situations arising in the dairy technician's schedule of work. Two Appendices to the book—one containing information, such as weight and measure conversion tables, price conversion tables, etc., and another containing questions on the contents of each chapter in the book add to the value of the book. Very few misprints occur, but on p. 27 listing enzymes of milk, Reductase has been described as an enzyme of bacterial origin which "reduces methylene blue, and gives, by the time required for reduction, an indication of bacterial content". This statement is incorrect in the light of present knowledge, since it is now accepted on all hands that the reduction of methylene blue to its leuco base is due to the oxygen uptake by bacterial cells rather than to the elaboration of any enzyme.

The book is written in a simple and lucid style and should prove useful to all those connected with routine examination of milk and milk products as well as to students of dairying. The get-up and printing of the book are excellent.

K. K. Iya.

A Century of Soil Science in Indonesia. By F. A. Van Baren. *O.S.R. Publication* 24. (Published by H. Van Ingen, Surabaya).

This is a communication from the Section of Mineralogy and Agreology, Faculty of Agricultural Science, University of Indonesia, Bogor, and consists of an introduction, two sections and a table of reference. In the introduction, the author states very truly that 'the history of many parts of the world teaches that, whenever the soil as a producing substratum deteriorates and becomes removed, every civilization inevitably disappears'.

In the first section, the development of interest in and understanding of the problems of soil fertility are dealt with. The scientific study of soil either for its own sake (Pedology) or in its applied form is of very recent origin not more than three hundred years at the utmost. In 1852, the first experimental plots were laid out in Buitenzorg, Java, by Dr. Fromberg and from that time on to date there has been a steady development of the study of soils of Indonesia, broken only by the years of Japanese occupation during World War II. Interest in coffee, tobacco and sugarcane soils started early and by 1873, it had extended to rubber, paddy and fish culture. A series of summarizations of important works contributed by workers follows in which practically every aspect of soil science, pure and applied, seems to have been tried.

In section two, which deals with Soil Conservation, is reviewed in a very brief and precise manner the attempts made not only to restore the fertility of the soils which had lost it by bad management, but also those made to maintain and improve soil fertility at a very high level. Most soil erosion control measures known to people all over the world appear to have been tried and often with great success. To conclude, the author is of the opinion that 'the fight against soil devastation is a task of the Government itself and has to be founded in regulations having the force of law'. The culmination of the hundred years of Soil Science is to be found in the establishment in 1947 of a Bureau of Land Use incorporated in the Forest Service. An excellent list of 94 references follows. The report is very readable, and one ends up with an ever-increasing admiration for the investigators of the past 100 years in Indonesia for their foresight, industry and courage in breaking out into new lines of work.

N. G. C.

SCIENCE NOTES AND NEWS

University of Madras: Award of Prizes

"THE MAHARAJA OF TRAVANCORE-CURZON PRIZES" for 1951-52.—Two prizes, one in each of the following groups of subjects, will be awarded by the Syndicate for the best essay or thesis *written by any Graduate of the Madras University* on any topic dealing with one of the subjects mentioned below:

D	E
Archæology	Pharmacology
Anthropology	Pathology
	Bacteriology

The value of each prize is Rs. 250.

The prize will *not* be awarded to the same applicant on a second occasion.

Theses should reach the Registrar not later than the 1st March 1952.

"SIR WILLIAM WEDDERBURN PRIZE, 1952".—The prize, which will consist of books of the value of Rs. 45, will be awarded to the student, who is qualified in Chemistry for the Degree of B.Sc. (Honours) or M.Sc. not more than two years previously. A thesis on any research work conducted by the student should be submitted with the application.

The work submitted should not have formed the basis of a work for which any prize or a degree had been *previously* awarded, and should reach the *Registrar not later than 30th April 1952.*

Indo-Pacific Fisheries Council--Third Meeting

The Third Annual Meeting of the I.P.F.C. was held at Madras from February 1st to February 16th and was attended by Representatives of the Governments of Australia, Cambodia, Ceylon, France, India, Indonesia, Netherlands, Pakistan, Philippines, Thailand, United Kingdom, U.S.A. and Vietnam. The following international organizations were represented by Observers: FAO, PSC, SCAP, SPC, UNESCO.

The Council laid down a detailed plan of work in connection with the preparation of fishery bibliographies and a series of fishery handbooks. Recommendations were made for action to secure the widest possible dissemination within the region of information concerning fishery matters and also for the use of documentary films on fishery subject. The Council paid particular attention to the problem of providing trained personnel for the fishing industries of the region and adopted a plan for the development of projects for technical instruction.

A Simple Suction Pump

Sri. P. Kachroo, of the Botany Department, Gauhati University, writes:

The following modification of the common bicycle pump has been of great utility in my botanical trips to the hills for exhausting air from thallose liverworts, fern prothalli and flower buds. The modification consists in reversing the washer, and using a rubber cork of required dimensions with a solitary bore at the end of the rubber tubing leading to the pump, thus converting it into a suction pump. Pumping for 10-15 minutes 3 or 4 times during 24 hours is sufficient to sink the material, but care should be taken not to exhaust all the air at once, lest the material may collapse due to plasmolysis.

Dr. Inderjit Singh

A Travelling Fellowship has been awarded by the World Health Organisation to Dr. Inderjit Singh to visit U.S.A., U.K., Sweden and Switzerland. During his tour he will work at the Laboratory of Physiology, Yale University.

Diamond Tool Industry in 1950

As in previous years the Industrial Diamond Information Bureau, London, E.C. 1, has compiled a survey of the Diamond Tool Industry in 1950, utilising the main sources of supply of this literature. This year's report is subdivided into the following groups: Scientific Aspects, Diamond Radiation Counters, Ruling Diffraction Gratings, Gramophone Needles, Surface Finish, Hardness Testing, Shaped Diamond Tools, Truing of Grinding Wheels, Diamond Drawing Dies, Diamond Powder, Diamond Grinding Wheels, Glass and Quartz, Gemstone Polishing, Corundum, Diamond Drilling. Copies of this publication (11 pages mimeographed) can be obtained free of charge from the above address while the supply lasts.

Purchase of Scientific Materials and Films

The Government of India have agreed to allow import without a licence of certain items

of scientific materials (list circulated with Occasional Bulletin No. 24) and scientific films, ordered with the UNESCO Scientific Material Coupons and UNESCO Film Coupons. These coupons are on sale from the Ministry of Education, Government of India, New Delhi. The UNESCO Office at Delhi has also a supplementary stock of these two types of coupons. These coupons are usable like the UNESCO Book Coupons, orders to be placed with the manufacturers and distributors participating in the scheme.

German Research in Engineering and Metallurgy

Results of research sponsored by D.S.I.R. in Germany after the war are now available as Reports issued under the title "Sponsored Research (Germany)". The Reports now ready are of importance mainly to designers and users of gear-wheels, though metallurgists will find some of interest. These Reports are available to Industrial Research Departments, Universities and individual research workers and can be obtained only from the D.S.I.R., 5-11, Regent Street, London, S.W. 1.

New Journal for Experimental Parasitology

Experimental Parasitology, a new quarterly journal, will be launched in the summer of 1951. Dr. D. R. Lincicome, Stine Laboratories, Newark, Delaware, has assumed the duties of the Managing Editor and will be assisted by an Editorial Board composed of Drs. H. H. Anderson, T. von Brand, E. Bueding, A. C. Chandler, E. C. Faust, Q. M. Geiman, G. van Grembergen, C. G. Huff, A. Lwoff, J. Oliver-Gonzalez, C. B. Philip, W. P. Rogers, J. D. Smyth, and N. R. Stoll.

Original papers dealing with experimental approaches to problems in the field of parasitology will be eligible for editorial consideration; contributions that involve experimental physiological, metabolic, biochemical, nutritional and chemotherapeutic problems of parasites and host-parasite relationships are especially desirable. In addition to original research material a section of the periodical will be devoted to "Parasitological Reviews", covering all aspects of the field. These Reviews will be prepared upon the invitation of the editors.

Manuscripts may be submitted to the Managing Editor or to any Member of the Board of Editors. *Experimental Parasitology* will be published by Academic Press Inc., New York 10, N.Y.

Nuclear Power Plant

Sir John Crockcroft, Director of Britain's Atomic Energy Research Establishment at Harwell, observed in a lecture recently: "We are working on the development of an experimental nuclear power plant. This will consist of a pile operating at a temperature of perhaps up to 600 degress Centigrade. This heat will be transferred to a steam boiler and the steam raised will be used to generate power in the conventional way."

Nuffield Foundation Travelling Fellowships, 1951-52

The Nuffield Foundation Indian Advisory Committee consisting of Mr. G. L. Mehta (*Chairman*), Sir C. V. Raman and Sir J. J. Ghandy (*Members*), assisted by a few specialists, have selected five candidates, two for medical sciences, one for engineering, one for plant genetics and one for industrial relation and personnel management, whose names would be recommended to the Nuffield Foundation for the award of the Travelling Fellowships. The selected candidates will hear from the Nuffield Foundation by June 1951, regarding the centres in the U.K. where they would be offered the necessary facilities for carrying out their programme of work. The Indian Advisory Committee have also finalised its recommendations to the Nuffield Foundation regarding the subjects for the award of Travelling Fellowships for 1952-53 and the names of persons in the U.K. who should be invited to India as Visiting Professors during this year.

Forthcoming Symposia at the National Chemical Laboratory, Poona

Date	Subject	Organiser
May 4, 1951	Rubber and Rubber Waste	Dr. J. B. Pande
June 8	Organic Fine Chemicals and Industry	Dr. R. C. Shah
July 6	Chemicals for Agriculture	Dr. M. U. Pai & Dr. C. K. N. Nair
August 10	Chromatography	Dr. J. Gupta
Sept. 11-14	Vegetable Oils and Their Utilisation	Dr J. S. Agarwal

ERRATUM

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In the letter to the Editor, "On Thickness Lines in Relation to the Onset and Movement of Cold Waves in Western Pakistan and Northern and Central India during Winter"—

Column 1, last line:

"12° N." *should read as* "21° N."

Secretary: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc. Editor: G. N. Ramachandran, M.A., Ph.D, D.Sc., F.A.Sc. 1951 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for the Current Science Association, Bangalore